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Liess et al.

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(54) **APPARATUS AND METHODS FOR WEDGE LOCK PREVENTION**

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 12/435,253, filed on May 4, 2009, now abandoned.

(60) Provisional application No. 61/126,223, filed on May 2, 2008, provisional application No. 61/126,301, filed on May 2, 2008, provisional application No. 61/050,121, filed on May 2, 2008.

(51) **Int. Cl.**
E21B 23/00 (2006.01)
E21B 19/22 (2006.01)

(52) **U.S. Cl.**
USPC **166/382**; 166/77.1; 166/77.52; 166/77.53; 166/75.14

(58) **Field of Classification Search**
USPC 166/385.2, 77.1, 77.52, 77.53, 85.1, 166/75.14; 294/86.15, 86.17; 414/908, 910
See application file for complete search history.

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Primary Examiner — Cathleen Hutchins
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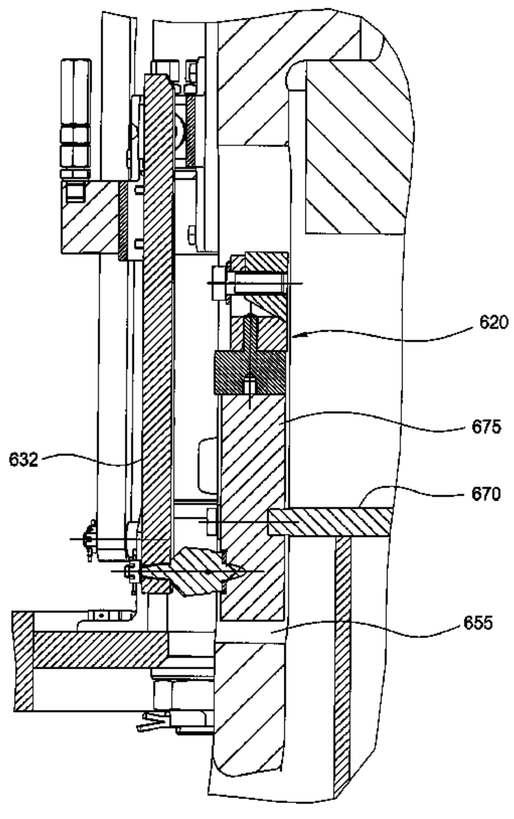
(57) **ABSTRACT**

In one embodiment, a tubular handling apparatus is provided with a wedge lock release mechanism that creates a clearance to allow movement by the mandrel having mating wedge surfaces relative to the tubular to release the wedge slips. In another embodiment, a tubular handling apparatus for handling a tubular includes a mandrel; a carrier coupled to the mandrel; a gripping element for engaging the tubular; an engagement member coupled to the carrier for engaging an upper portion of the tubular; and an abutment device adapted to engage the engagement member, wherein a length of the abutment device is adjustable to allow movement of the engagement member.

20 Claims, 35 Drawing Sheets



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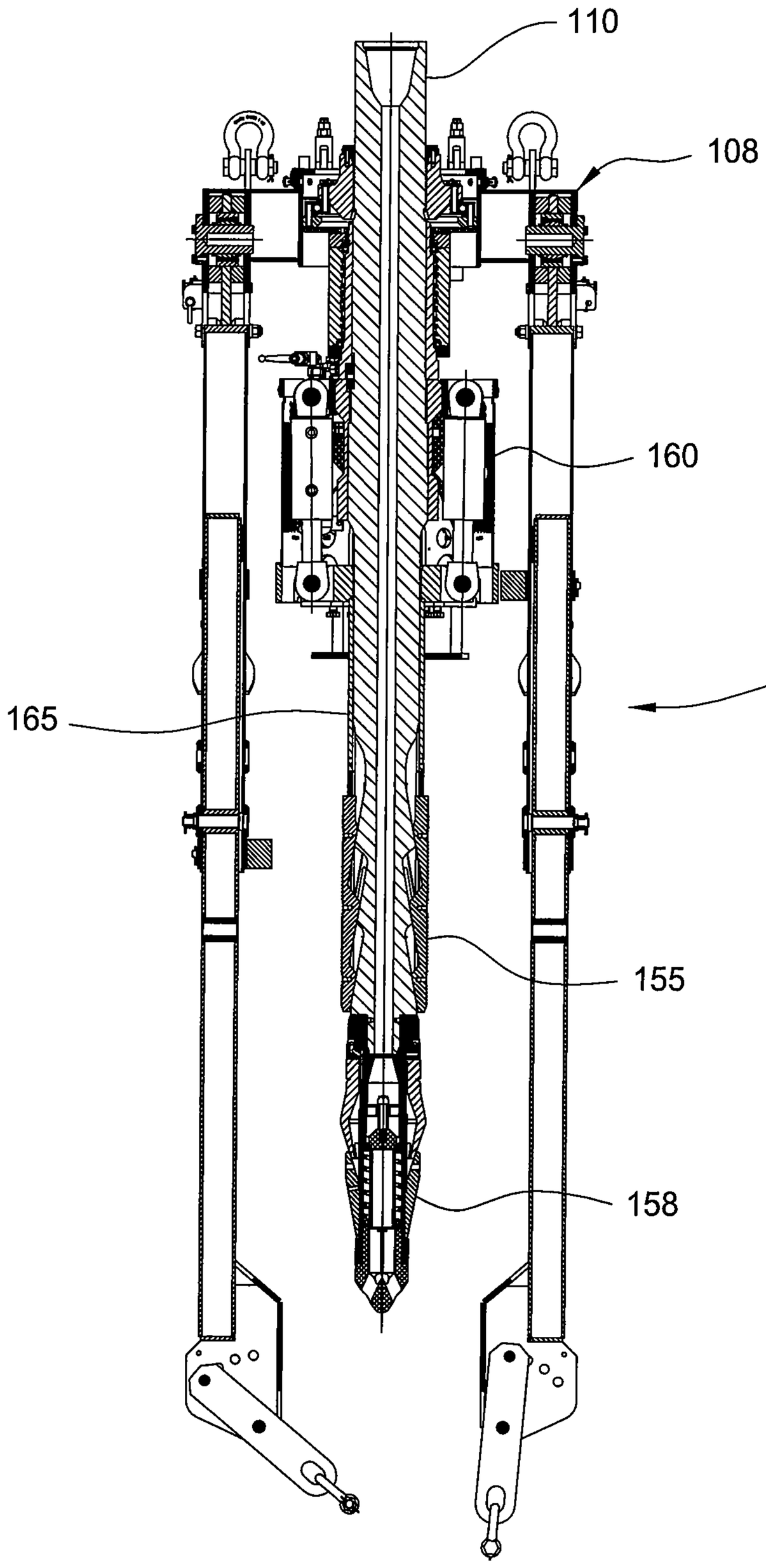

FIG. 1

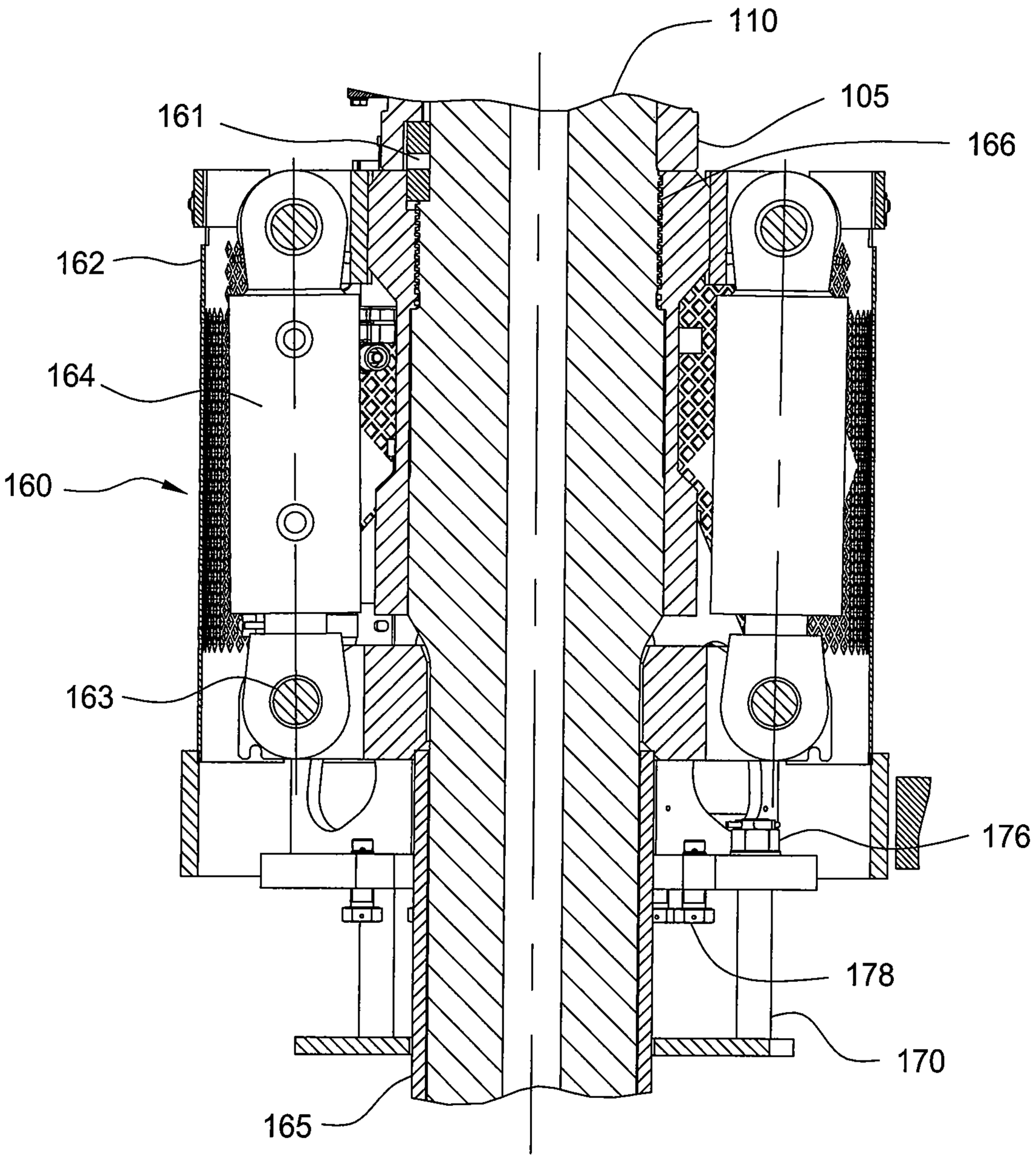

FIG. 2

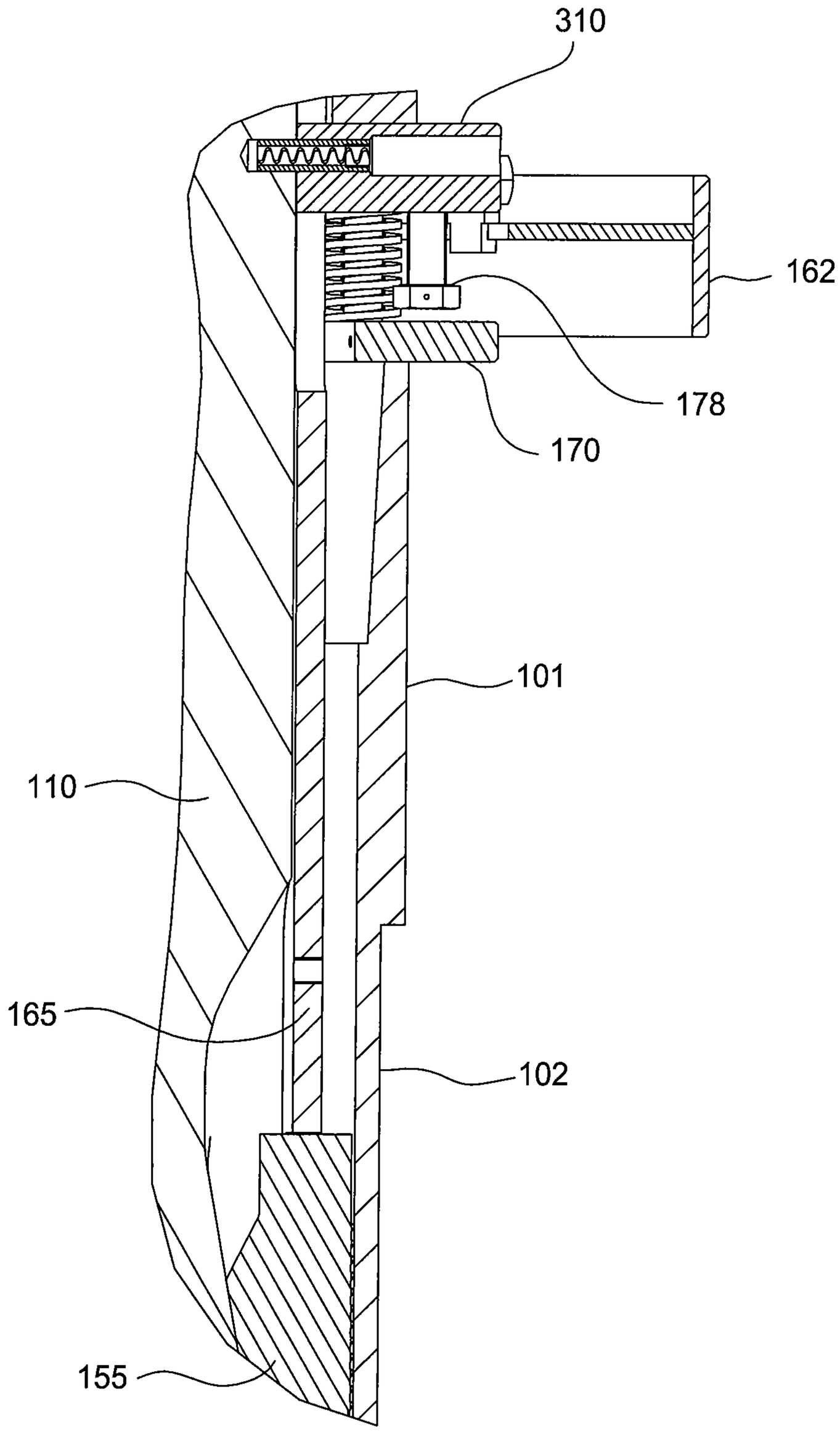

FIG. 3

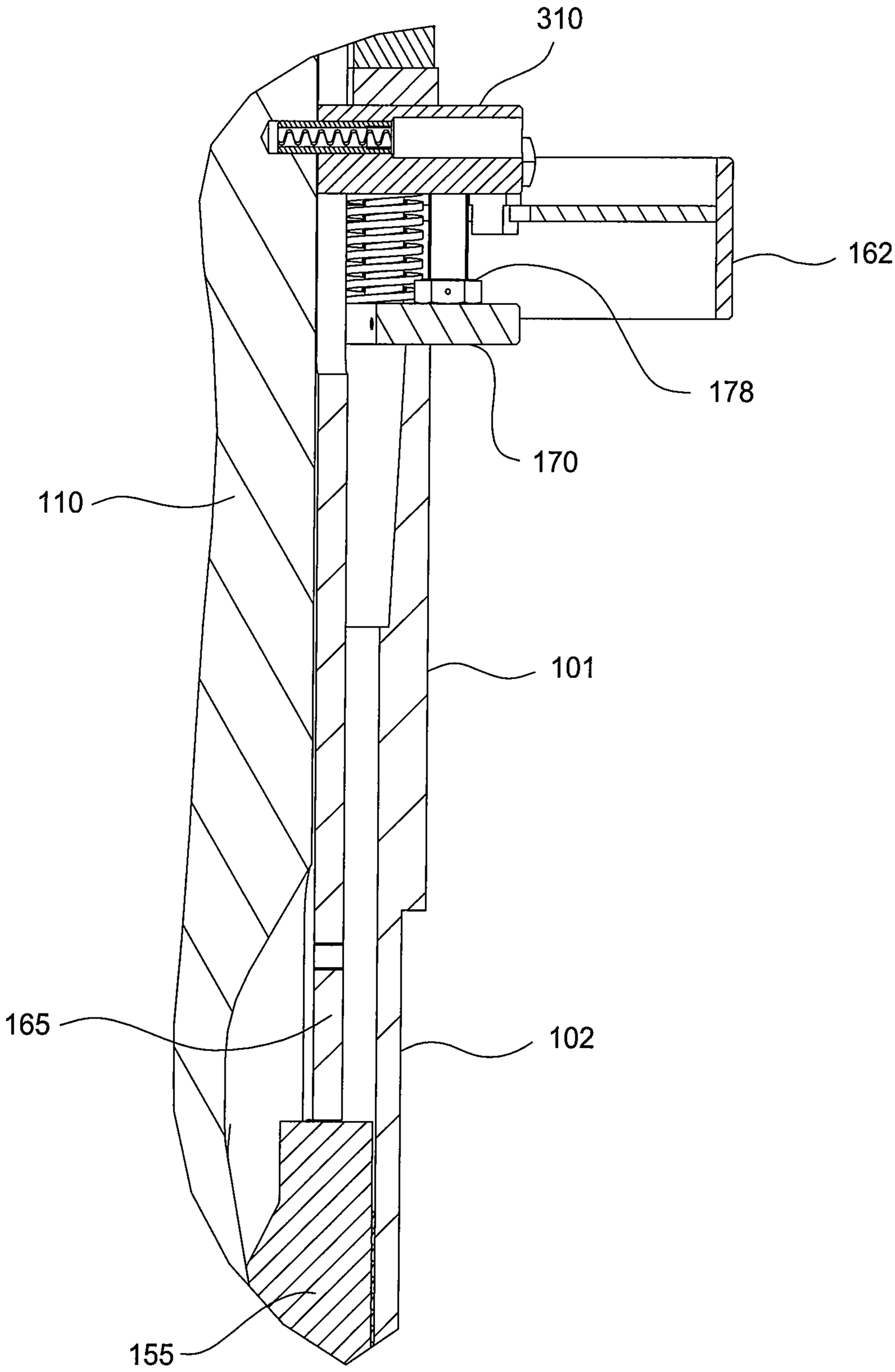

FIG. 4

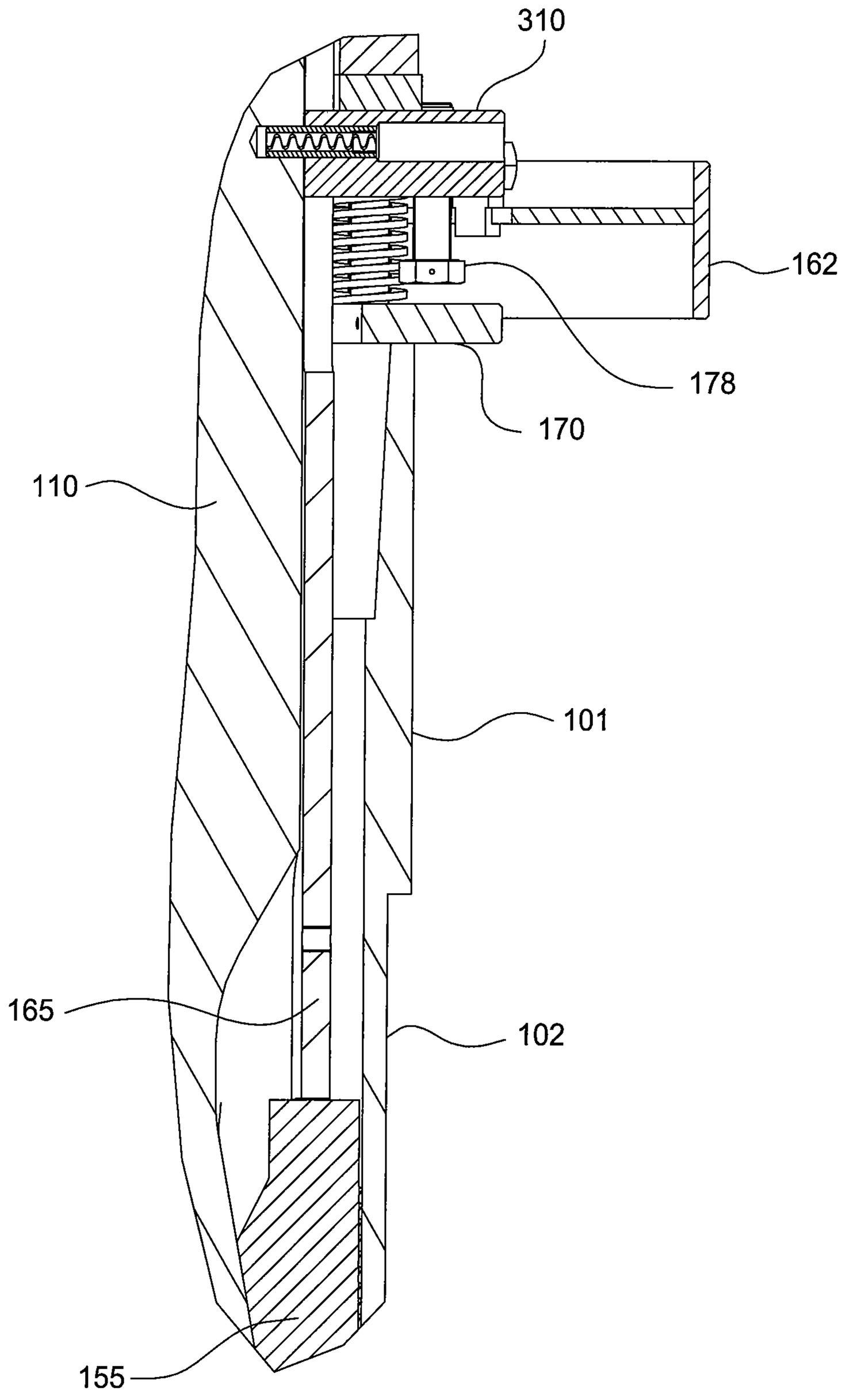

FIG. 5

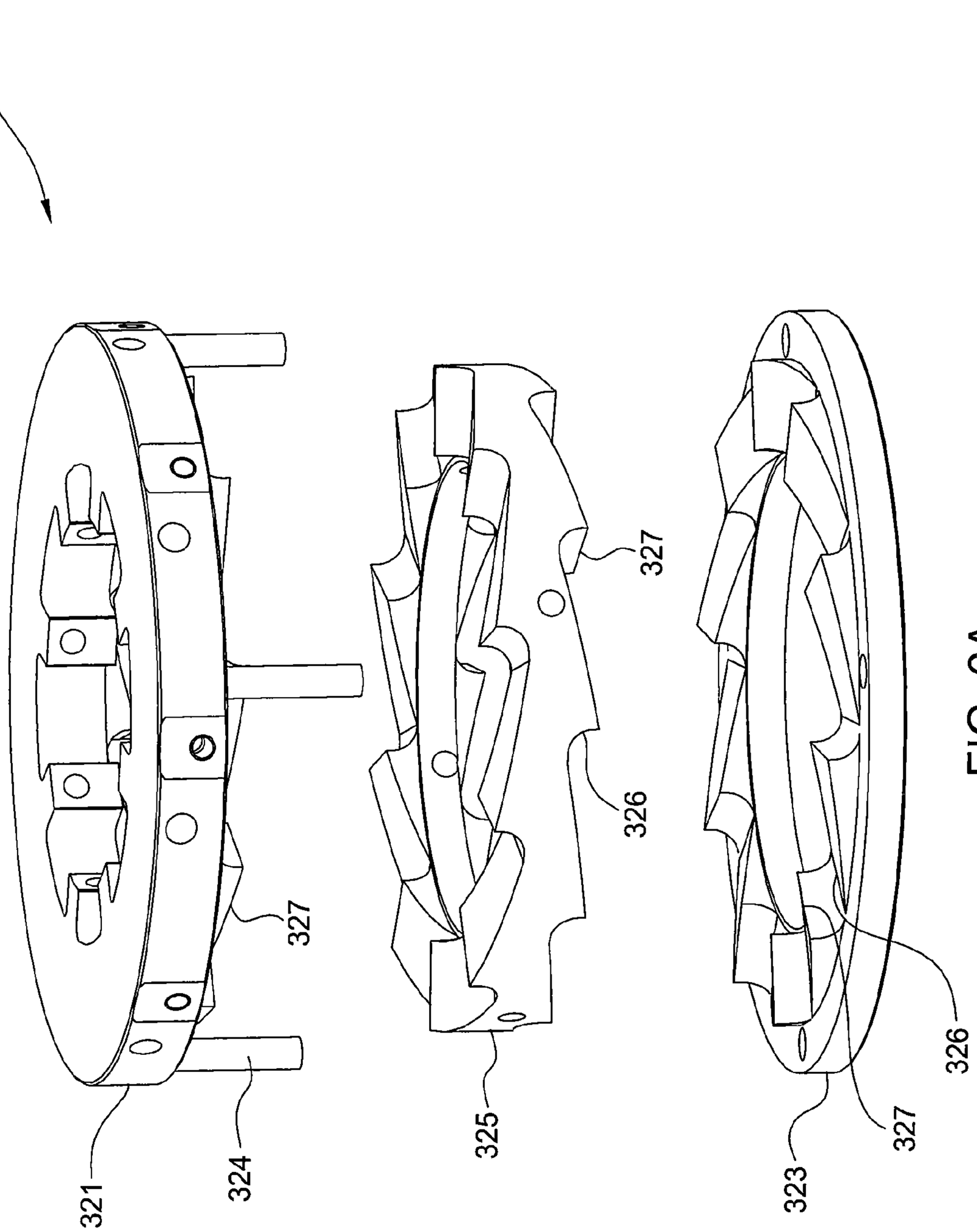

FIG. 6A

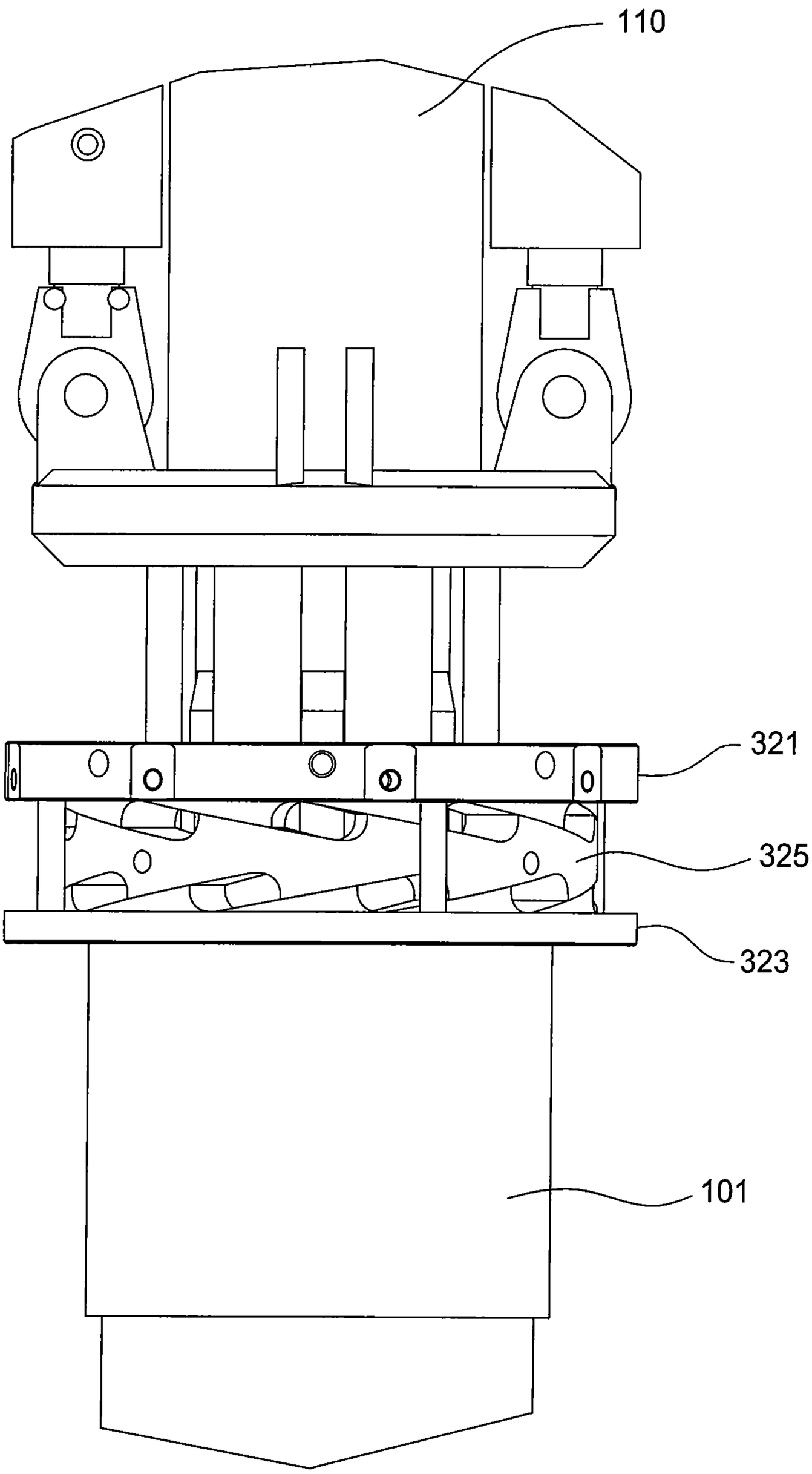

FIG. 6B

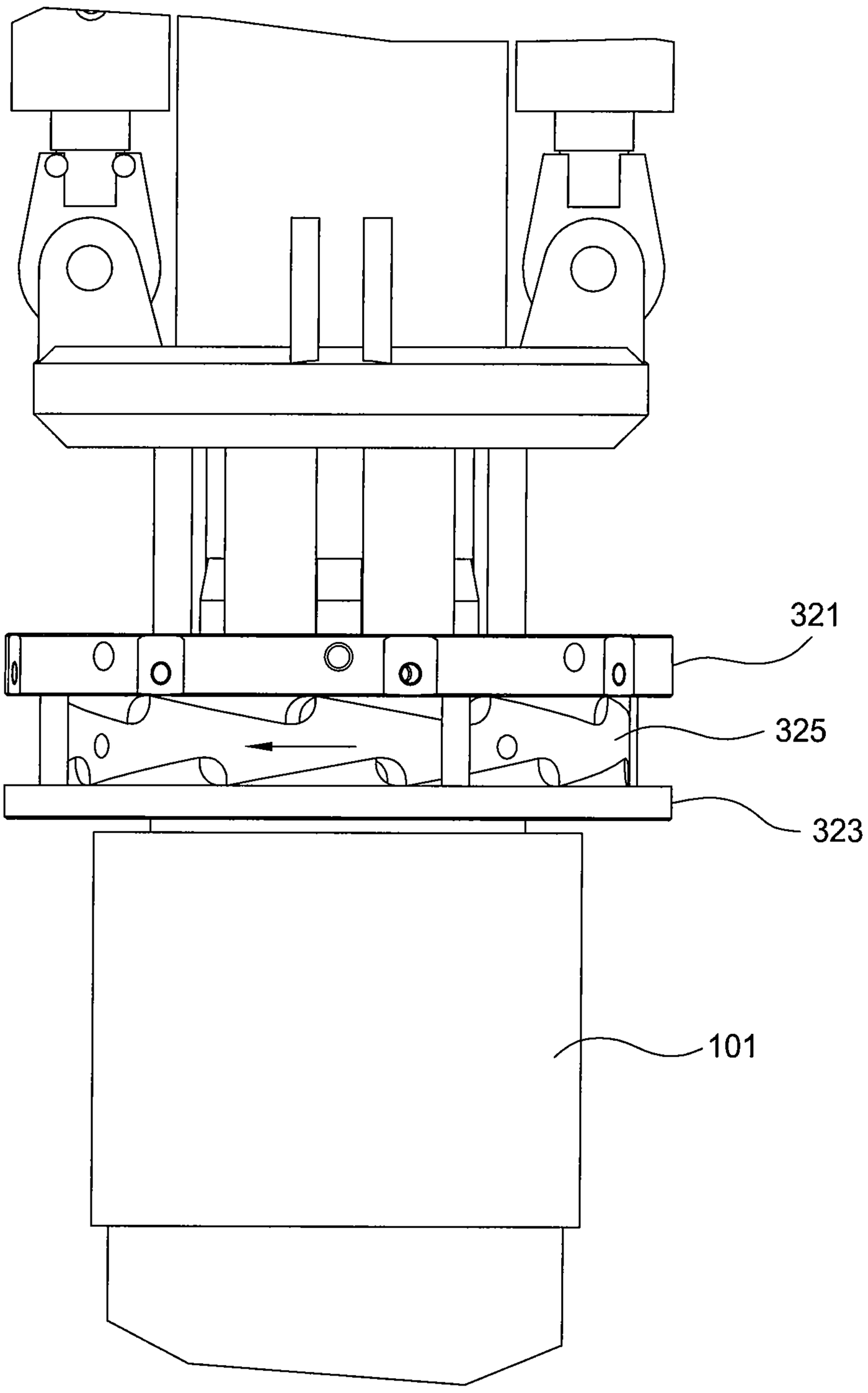

FIG. 6C

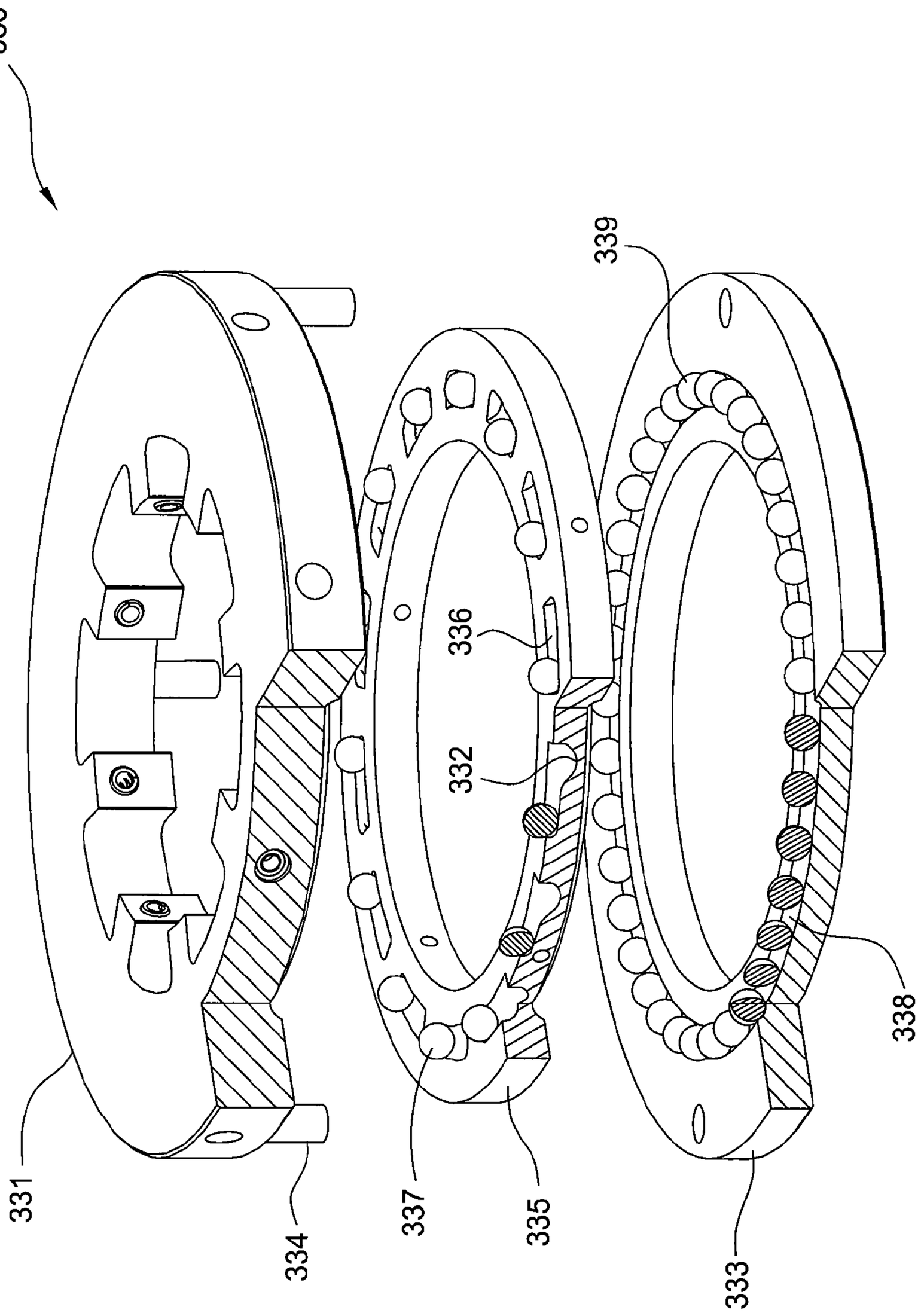

FIG. 7A

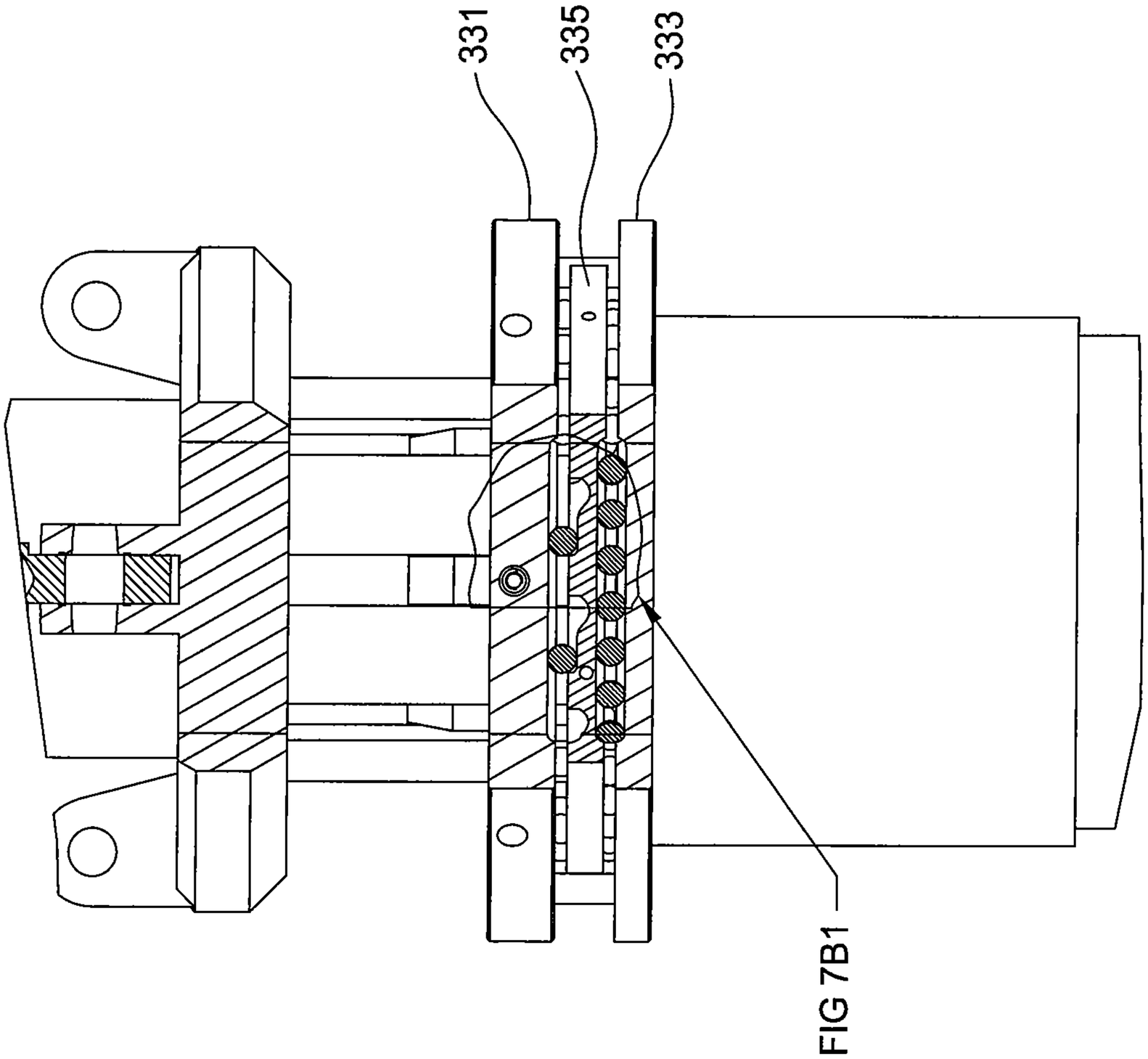

FIG. 7B

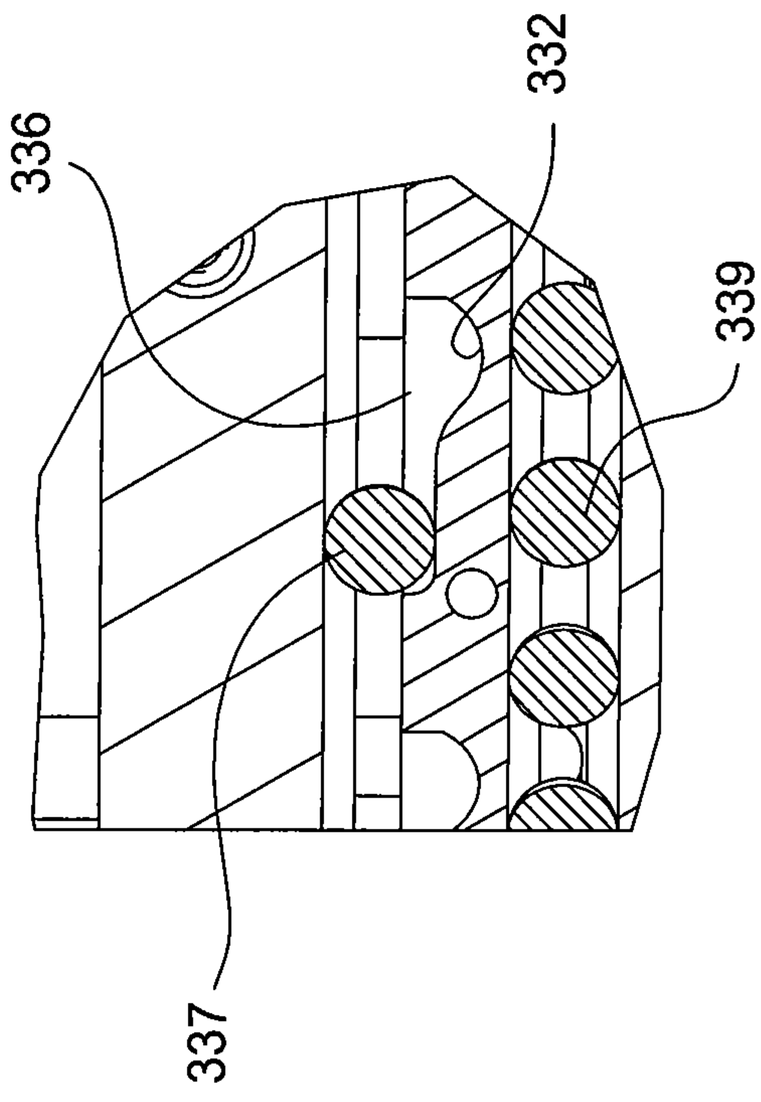

FIG. 7B1

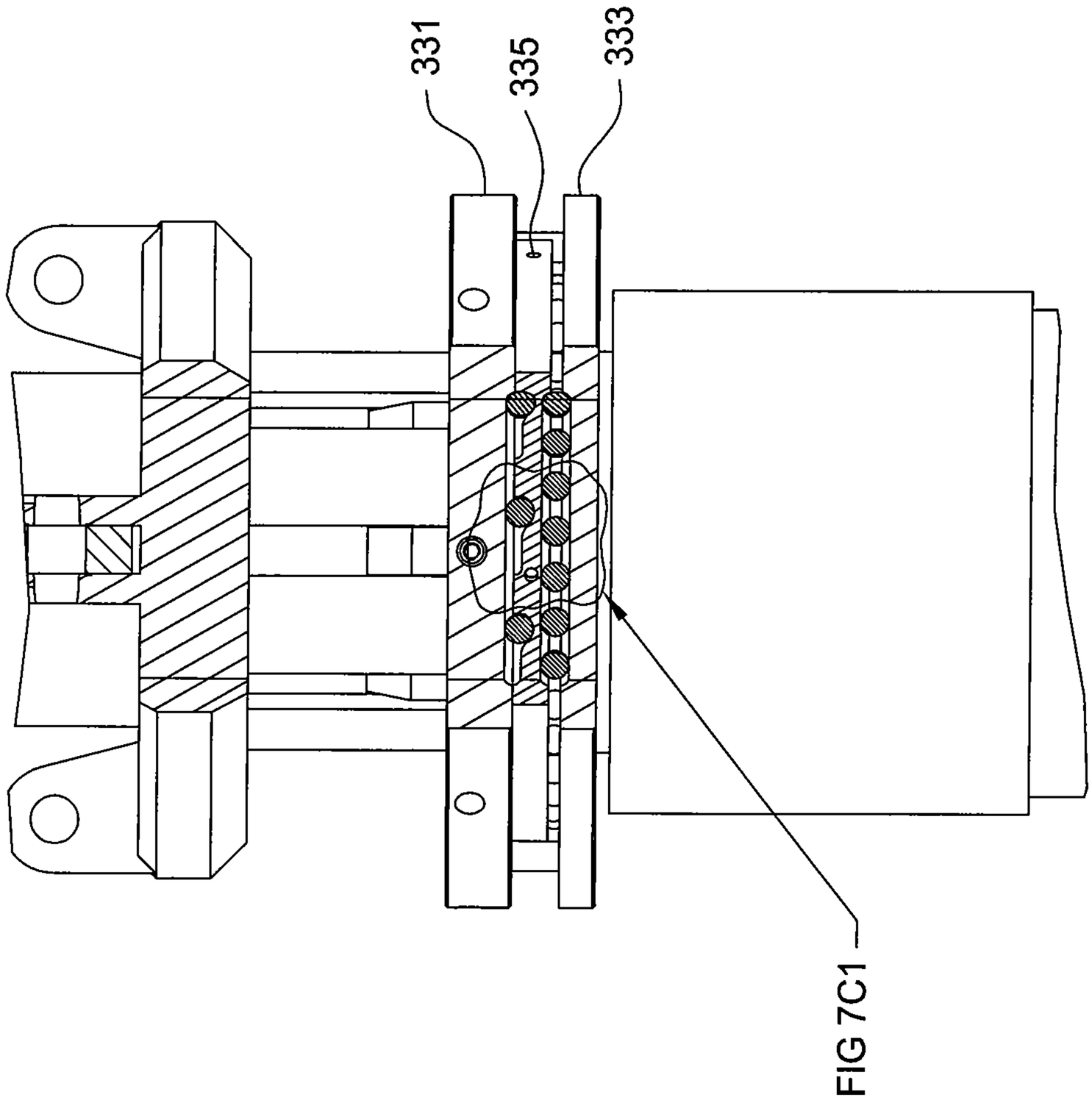

FIG. 7C

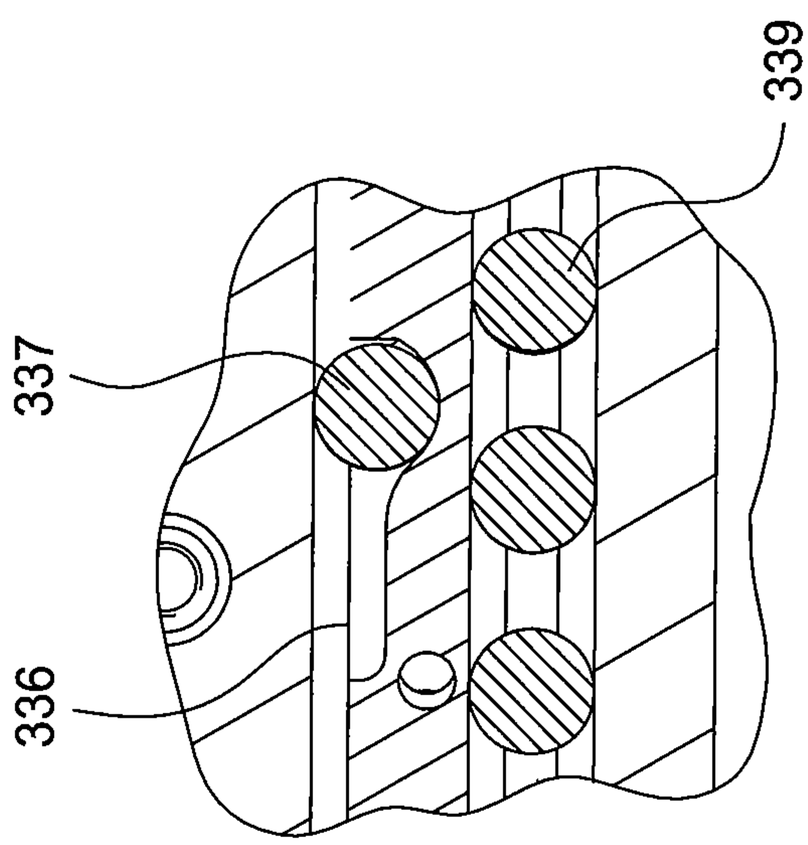

FIG. 7C1

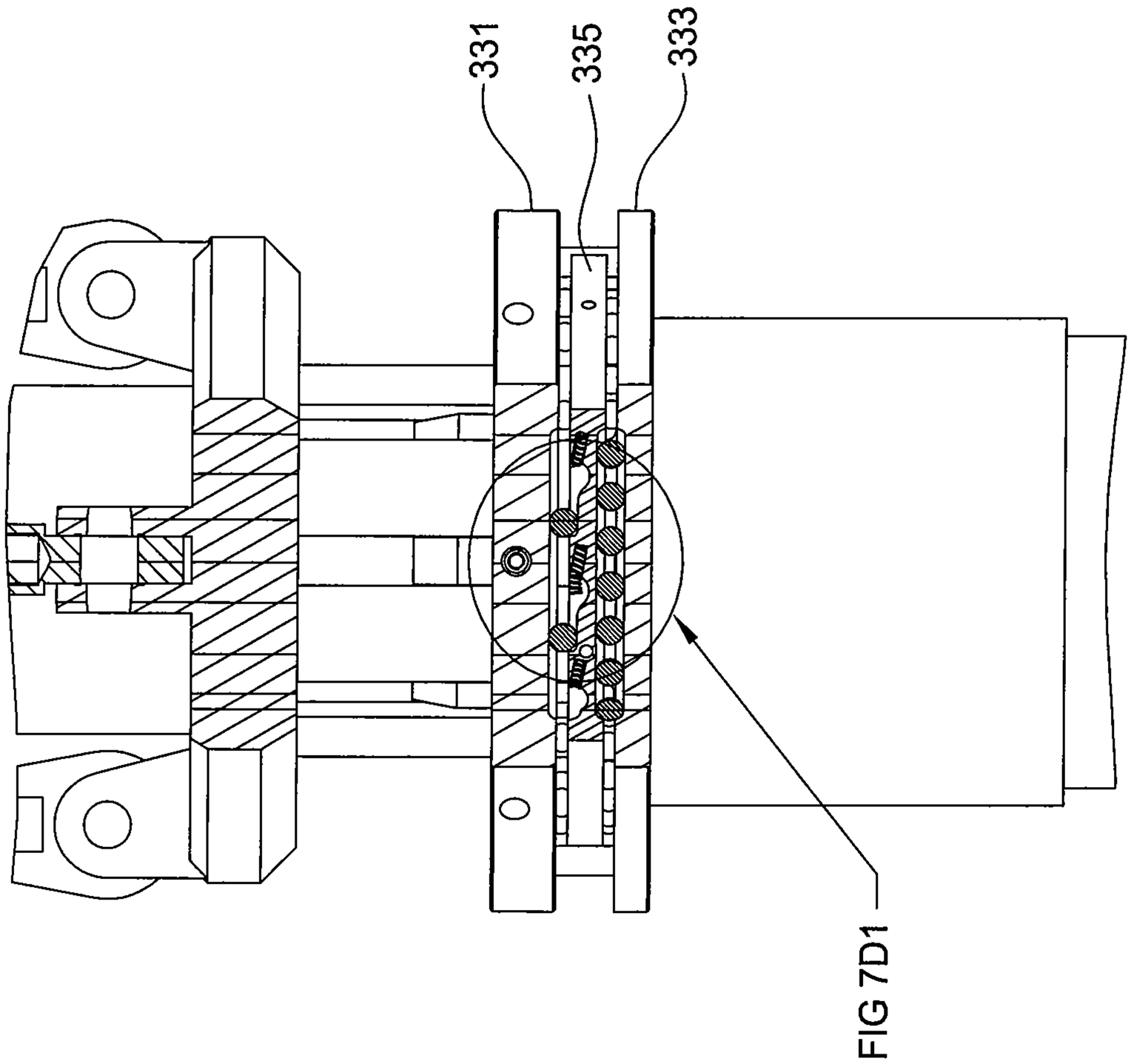

FIG. 7D

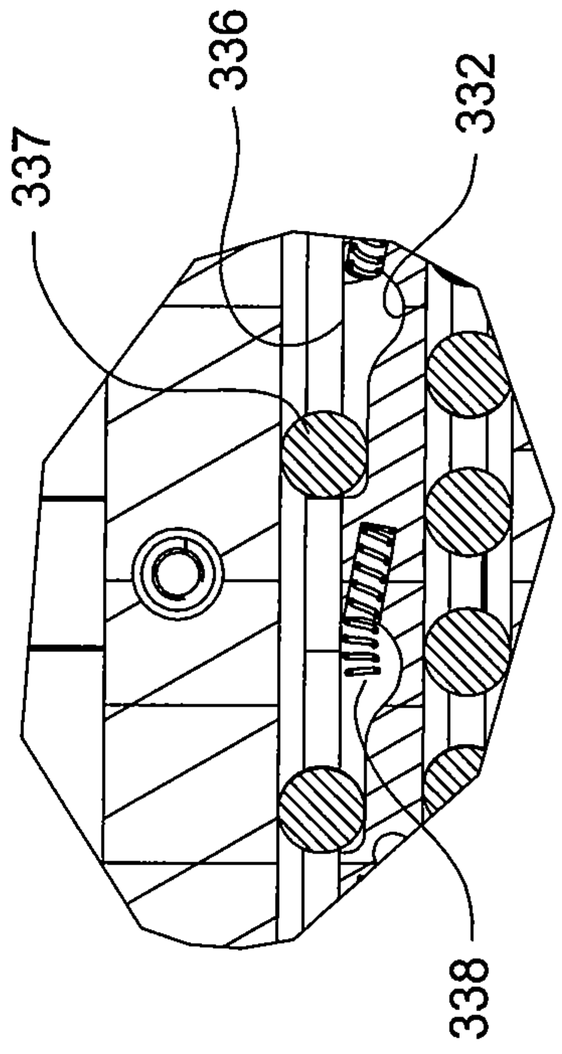

FIG. 7D1

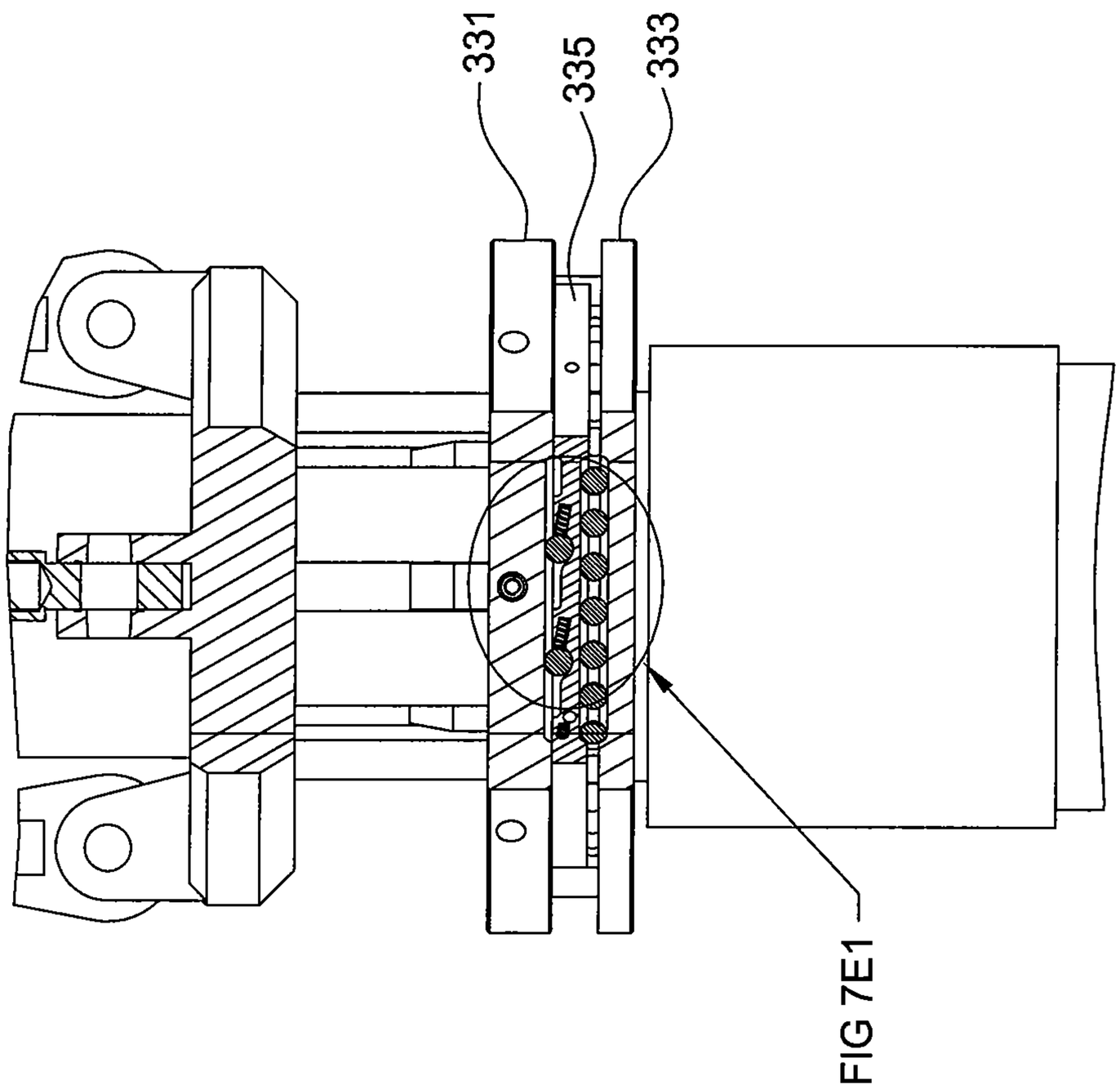

FIG. 7E

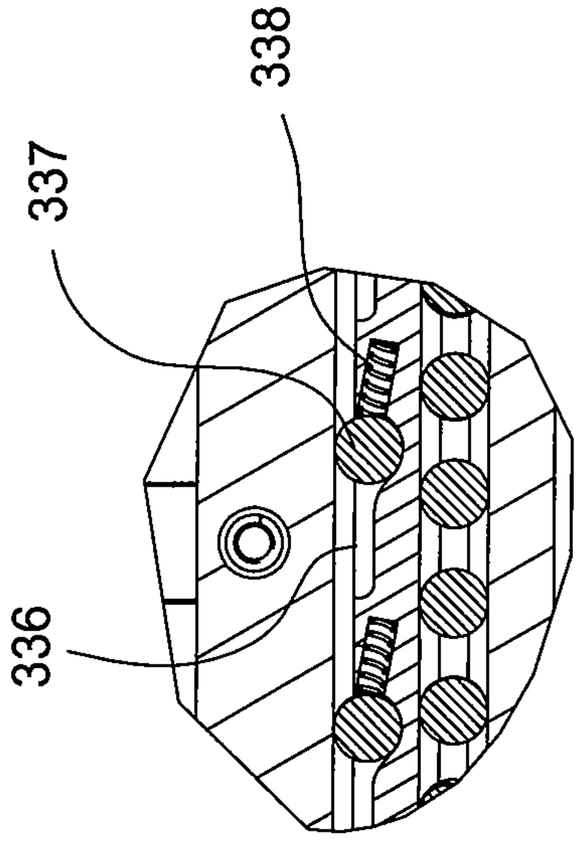

FIG. 7E1

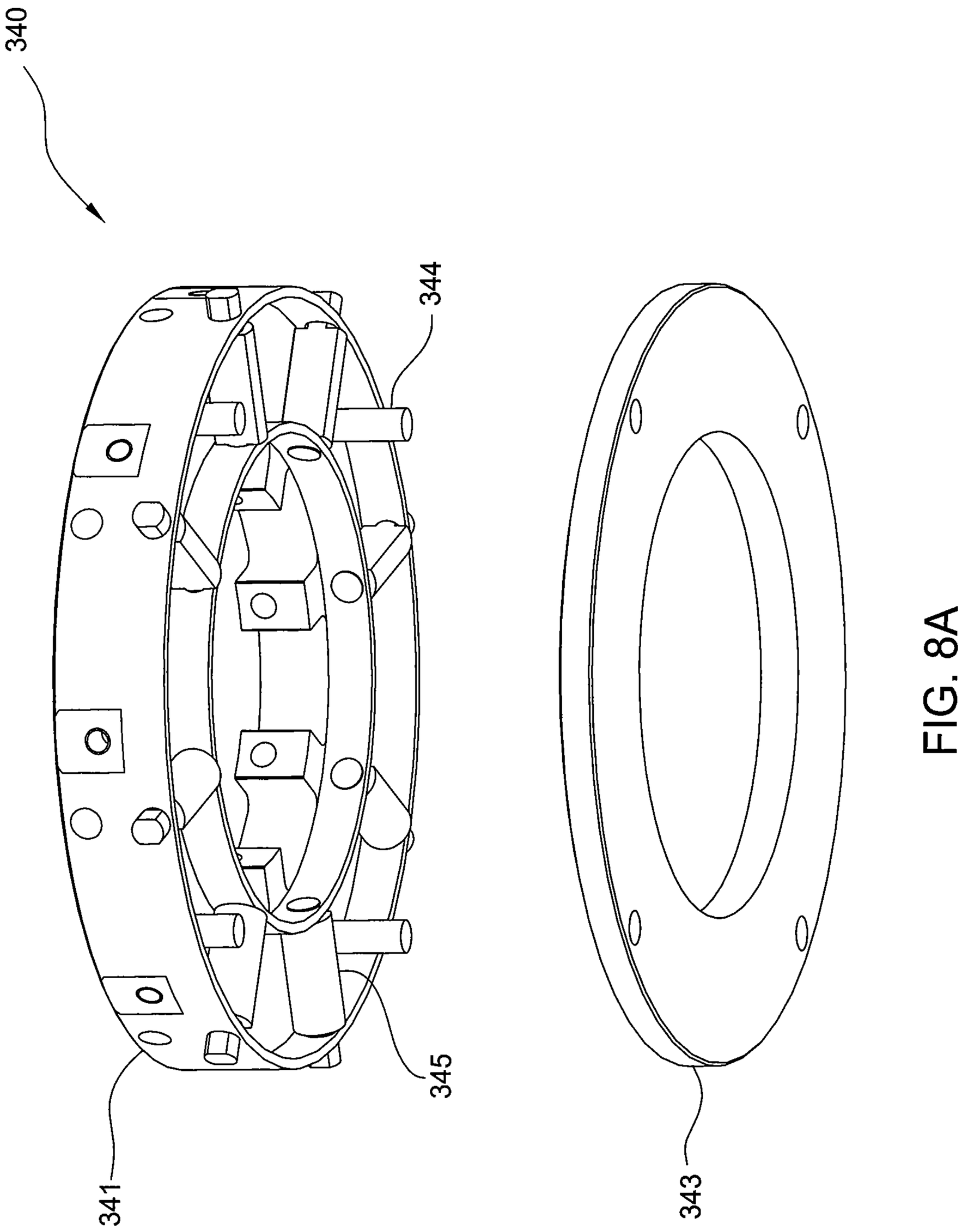

FIG. 8A

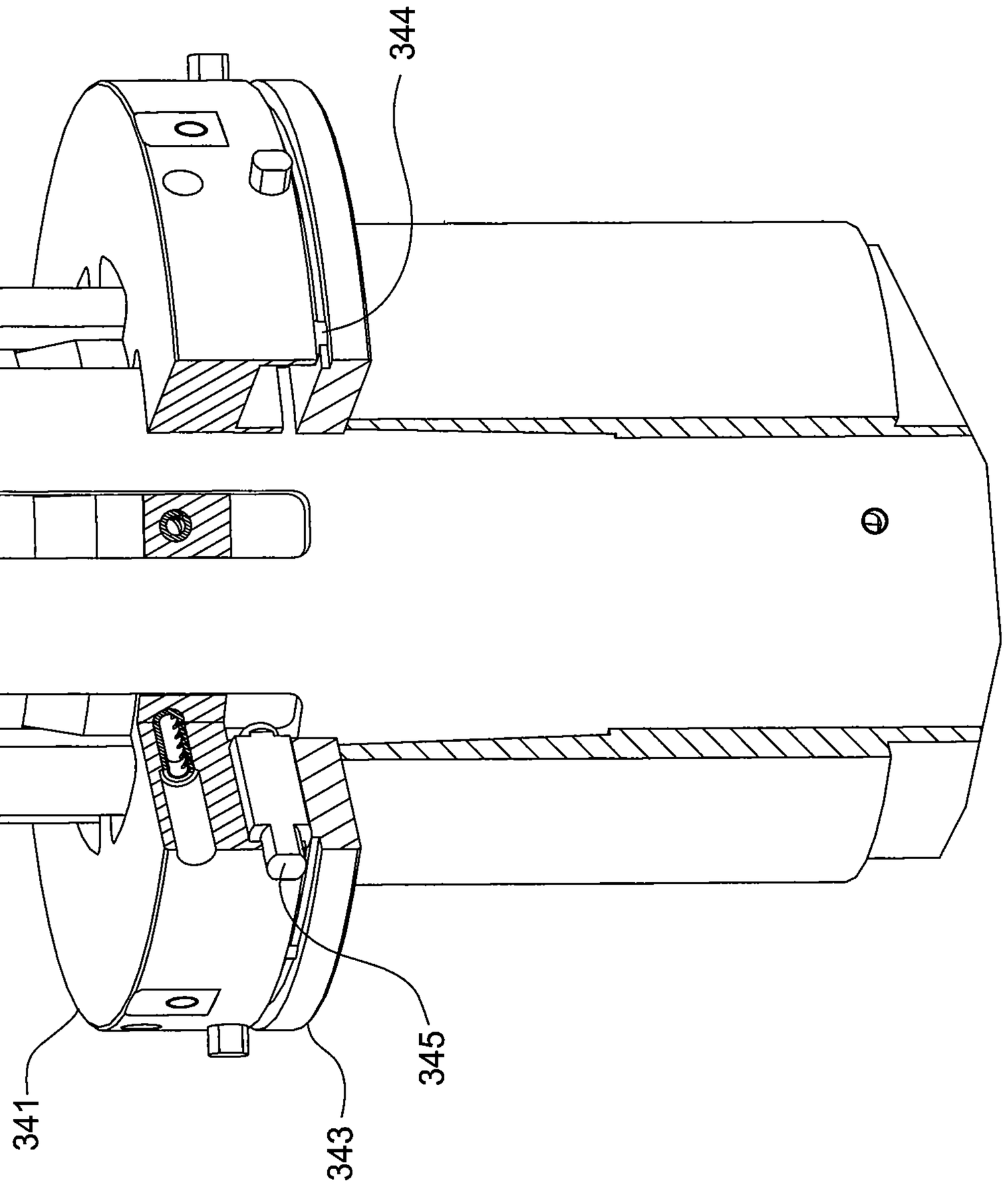

FIG. 8B

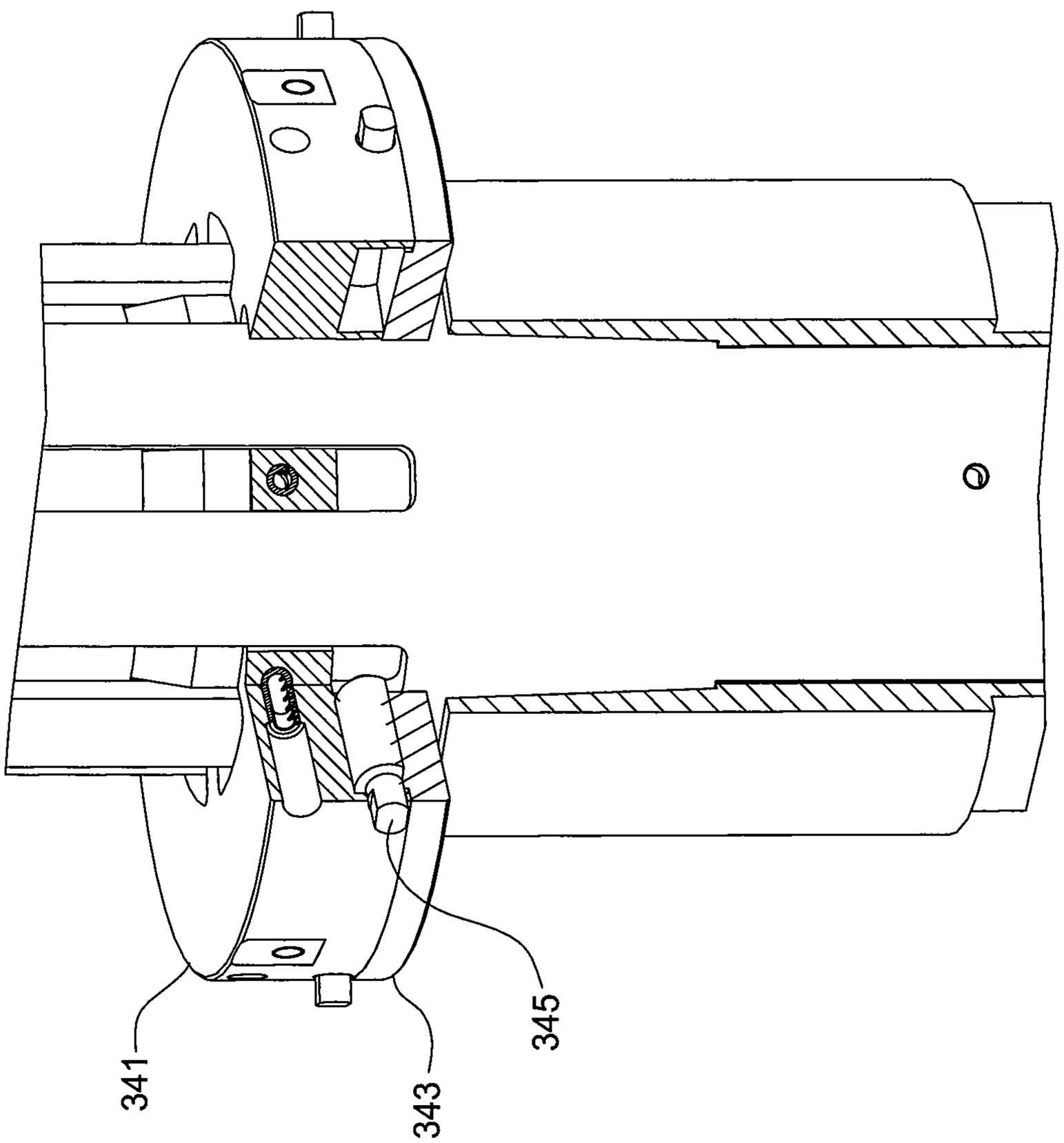

FIG. 8C

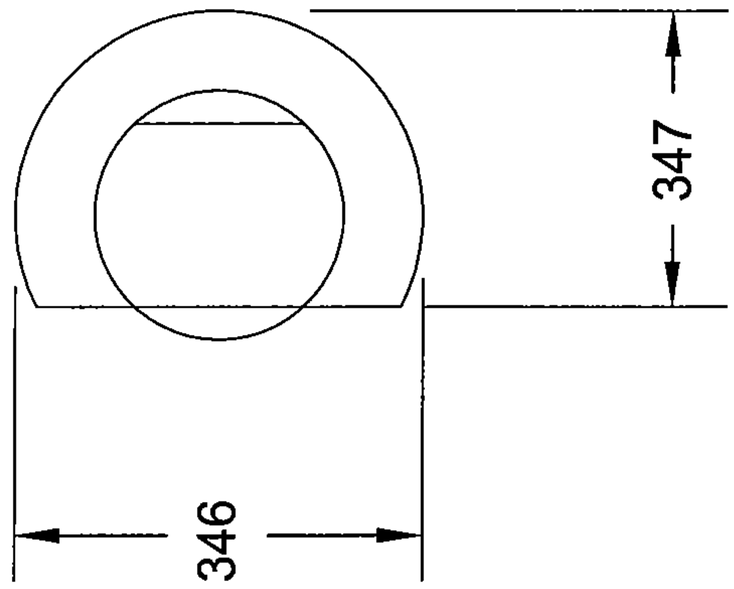

FIG. 8E

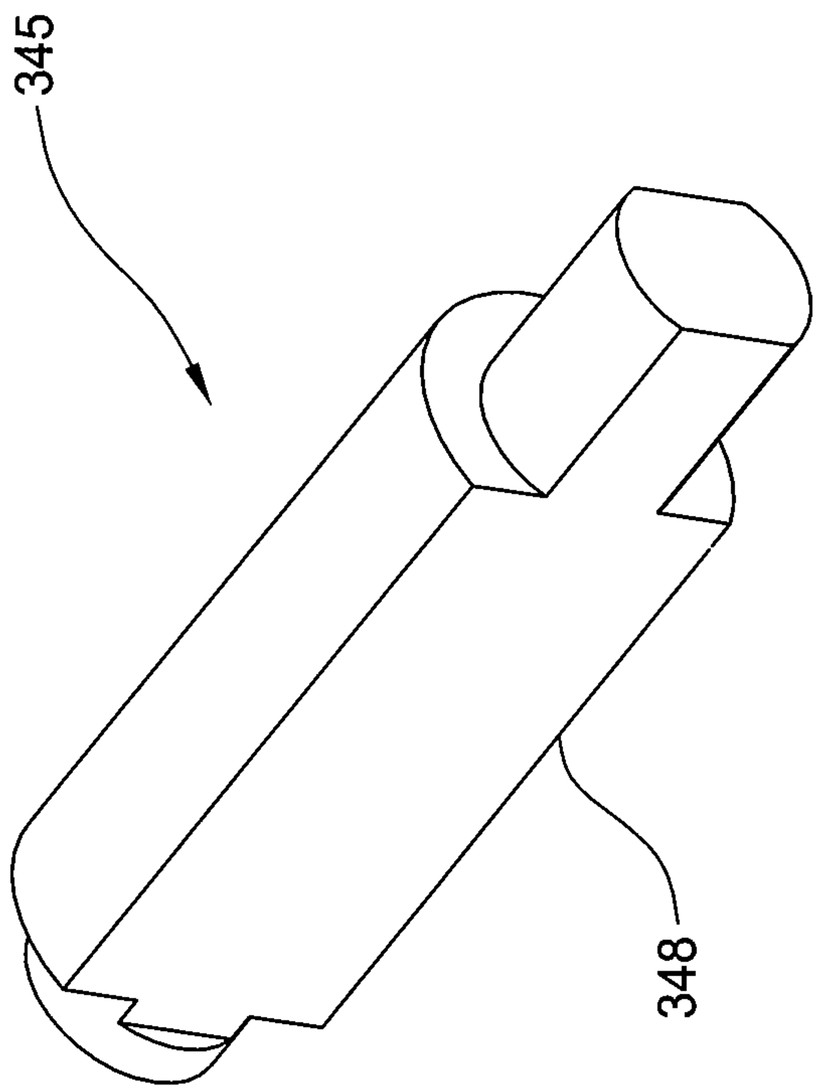

FIG. 8D

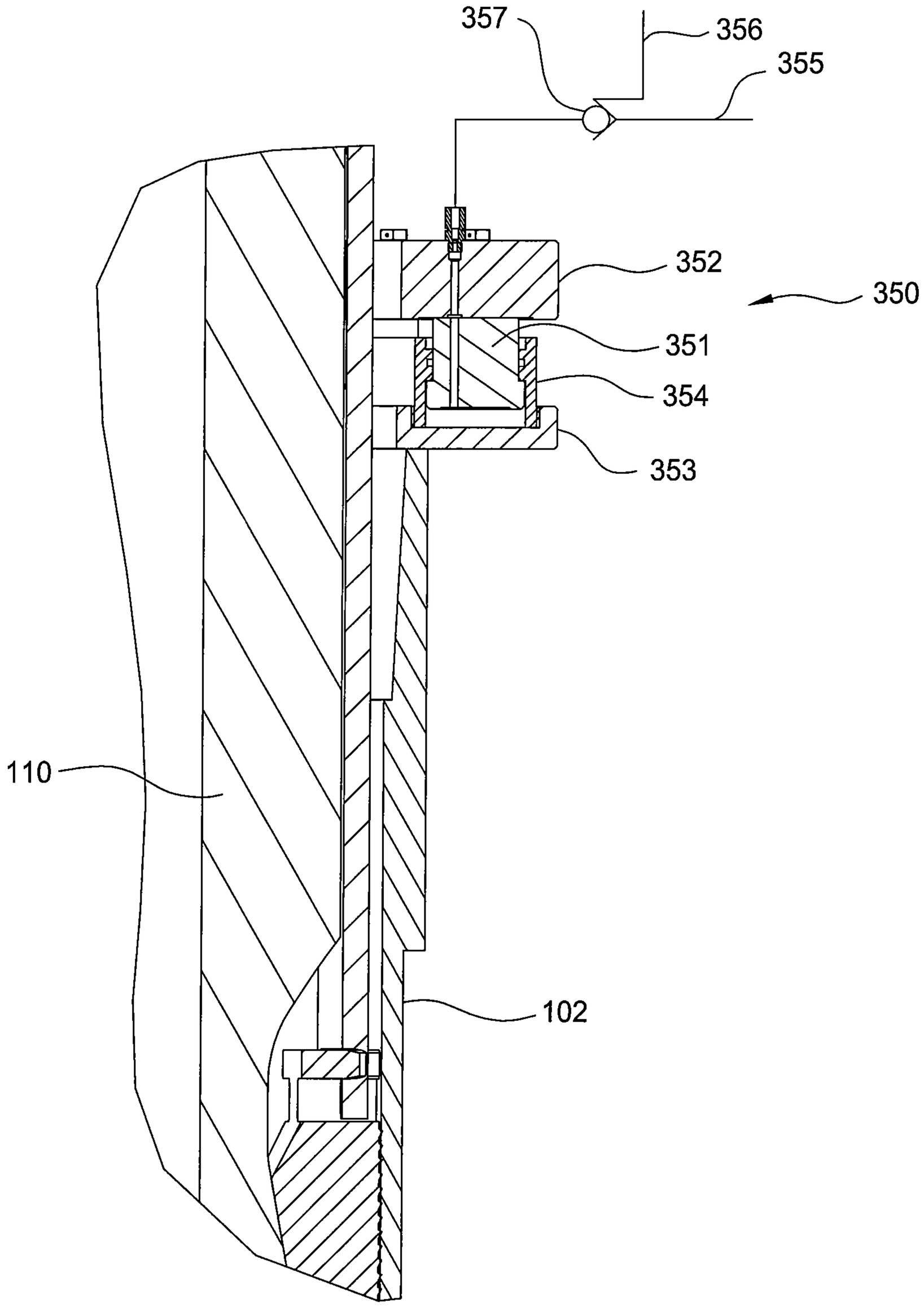

FIG. 9A

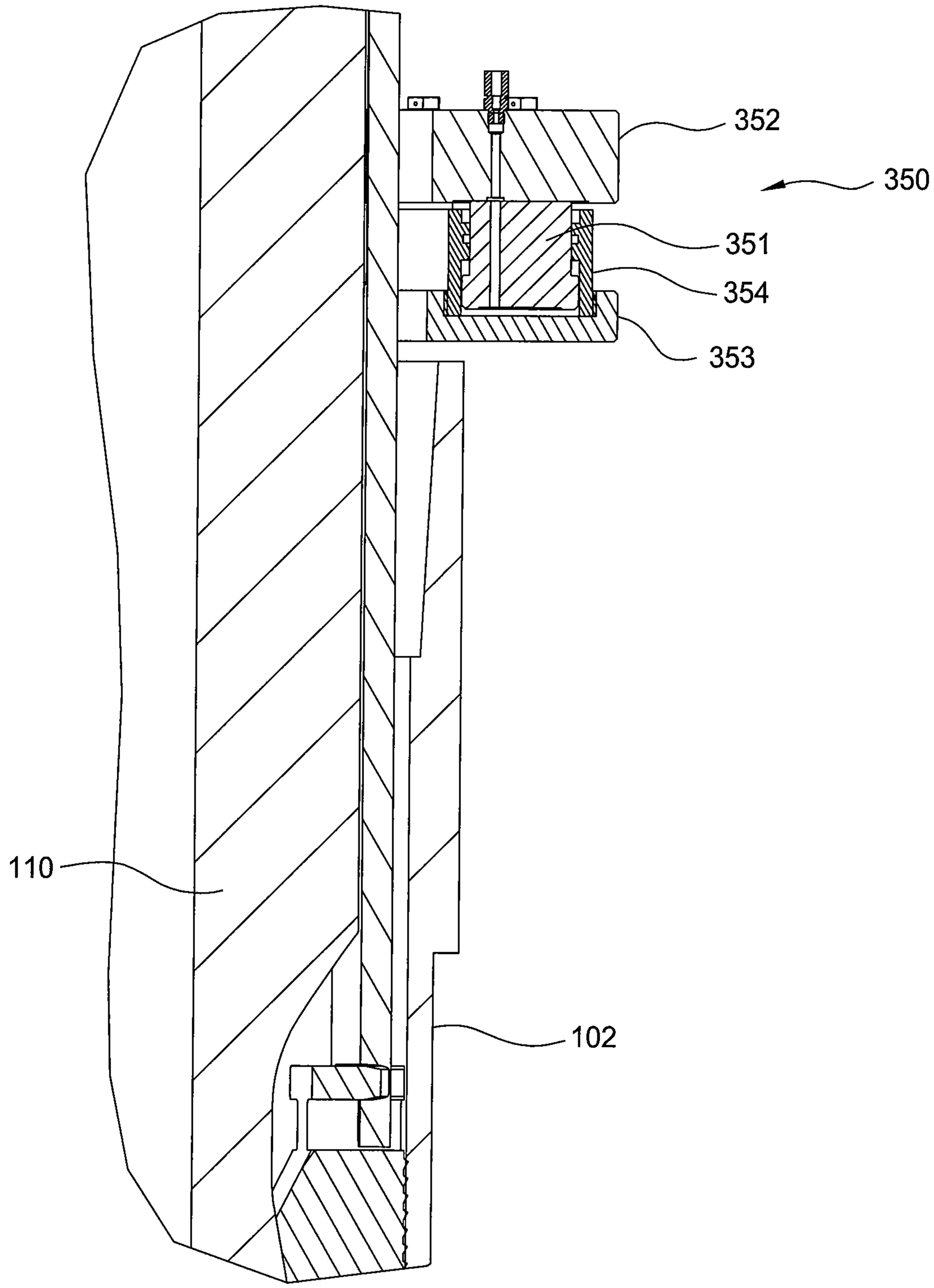

FIG. 9B

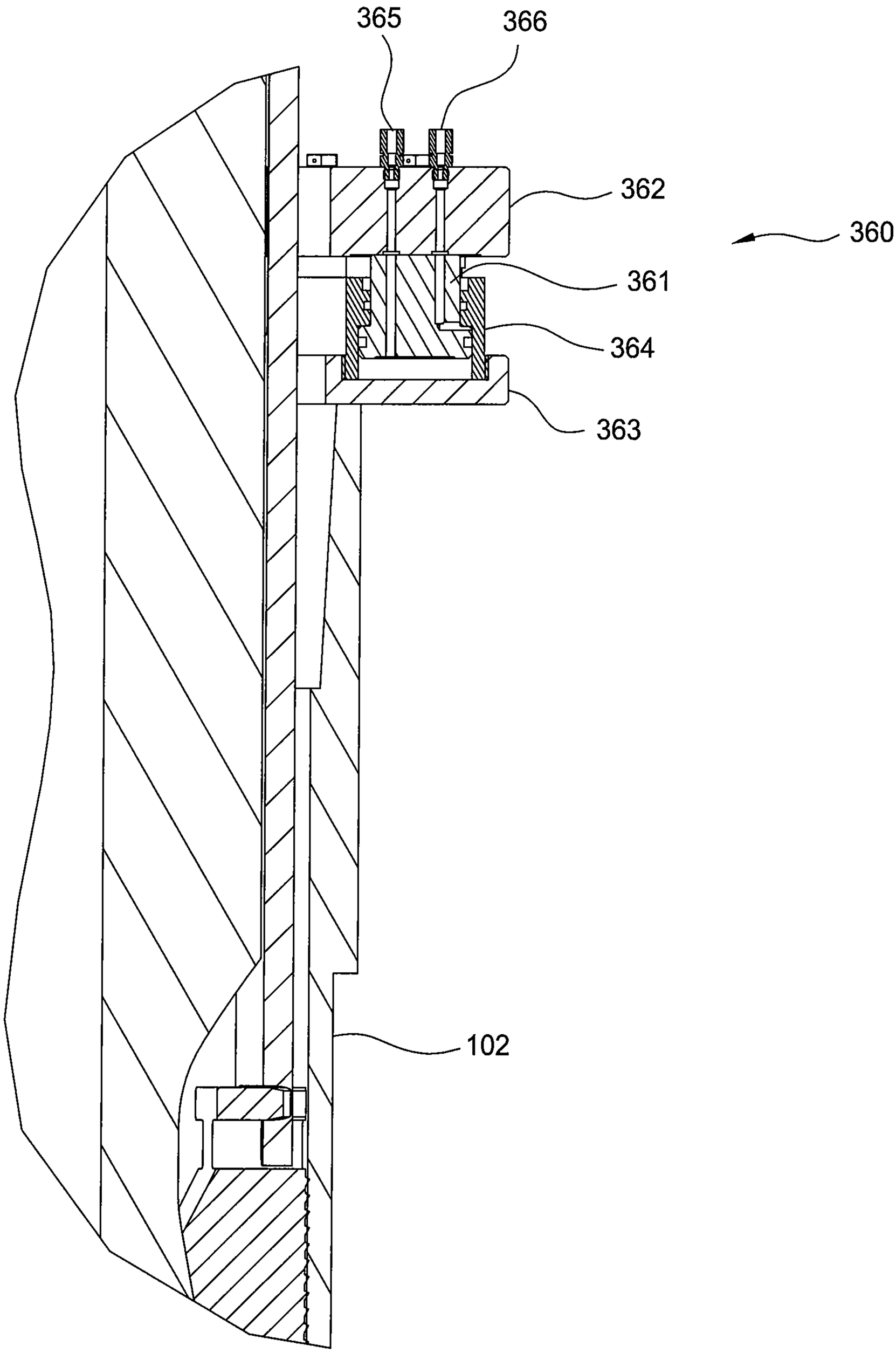

FIG. 10A

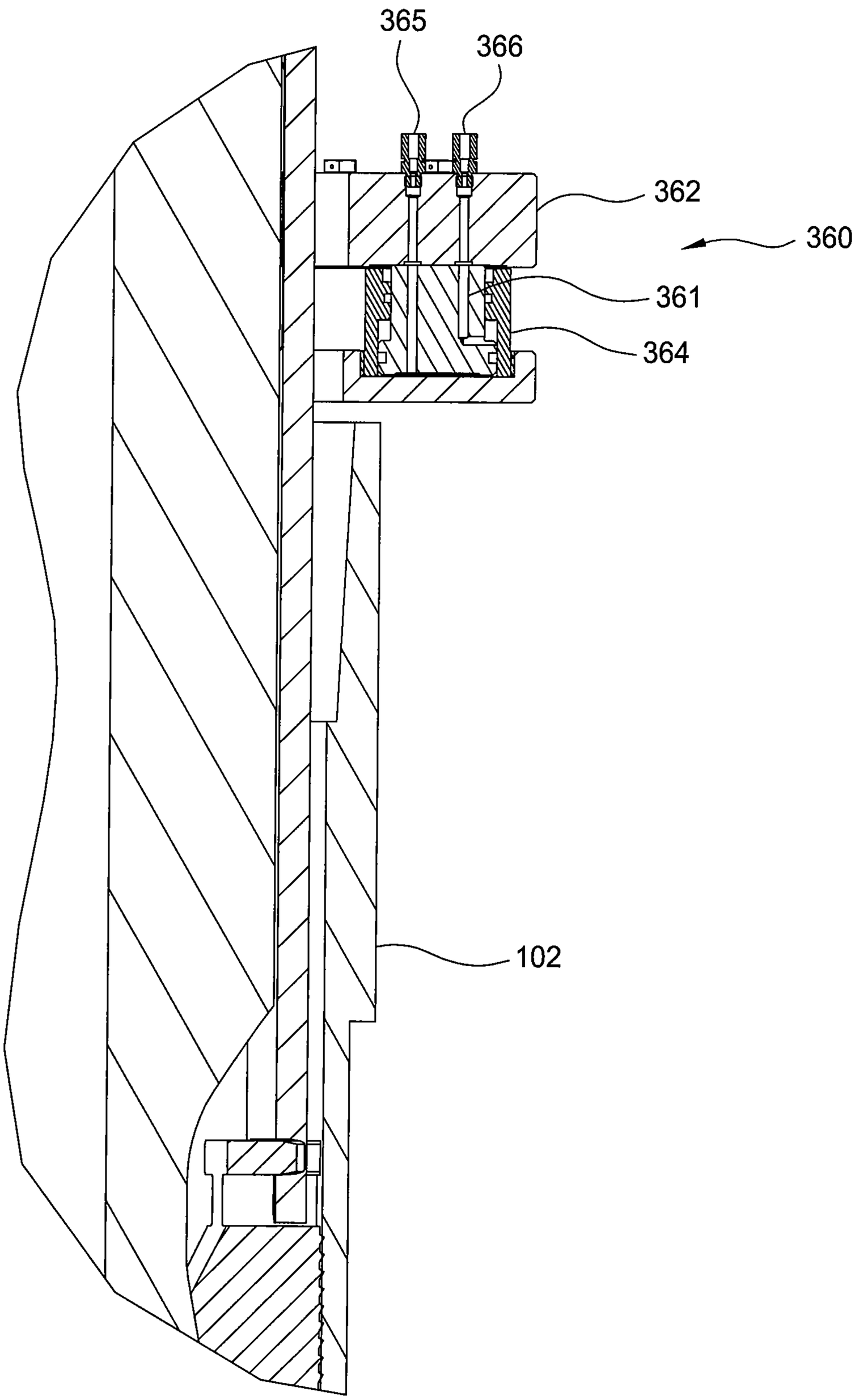

FIG. 10B

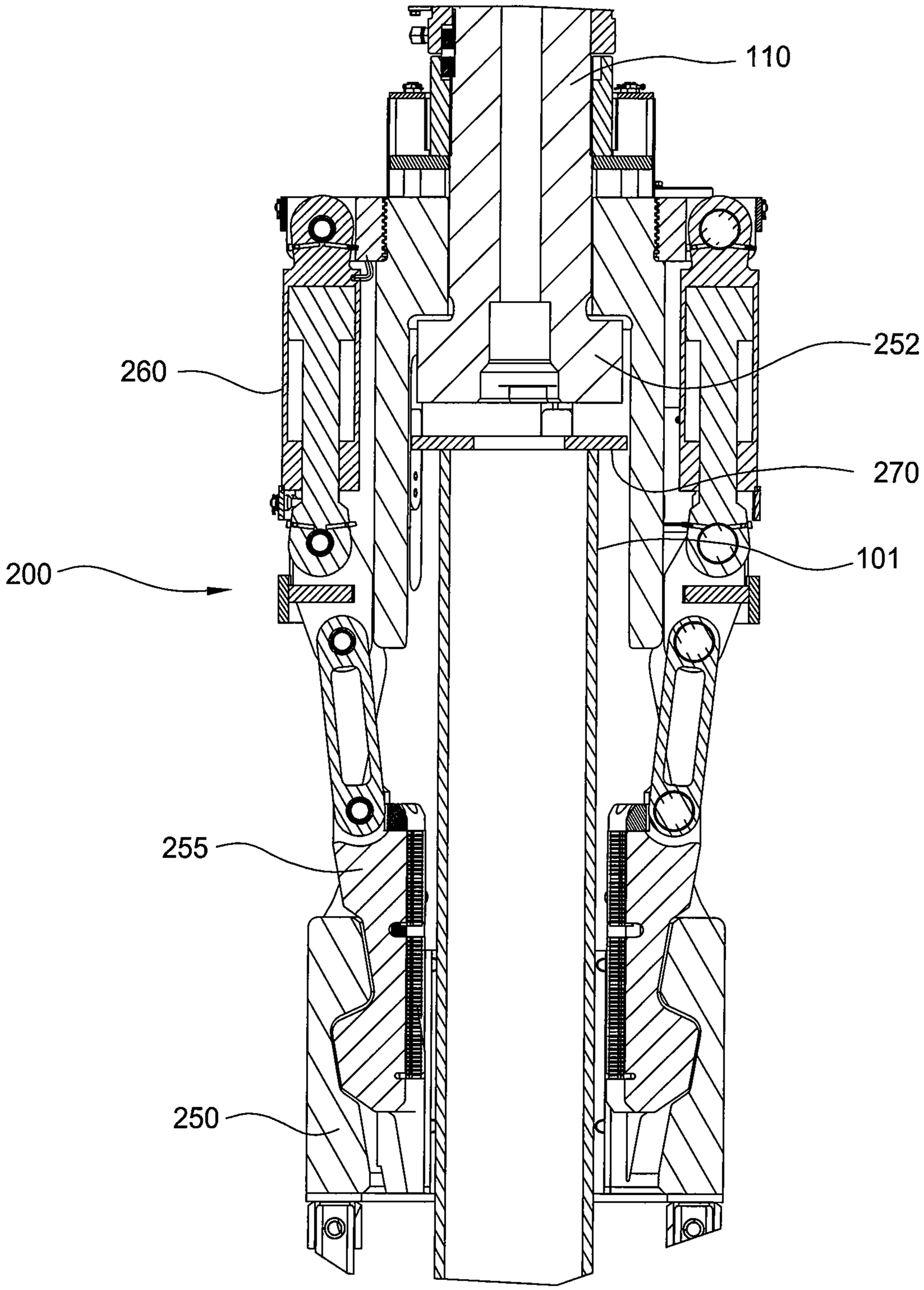

FIG. 11A

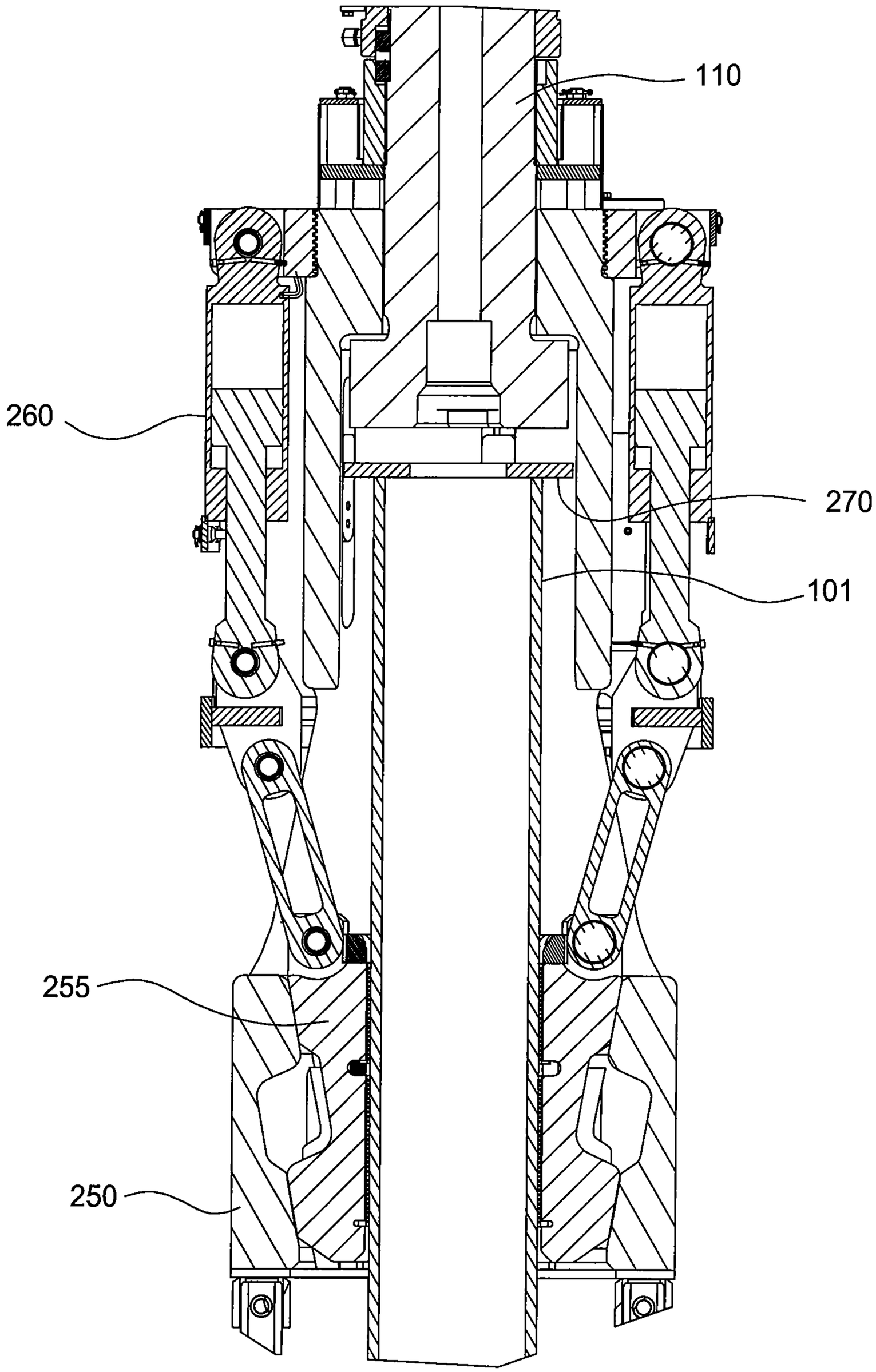

FIG. 11B

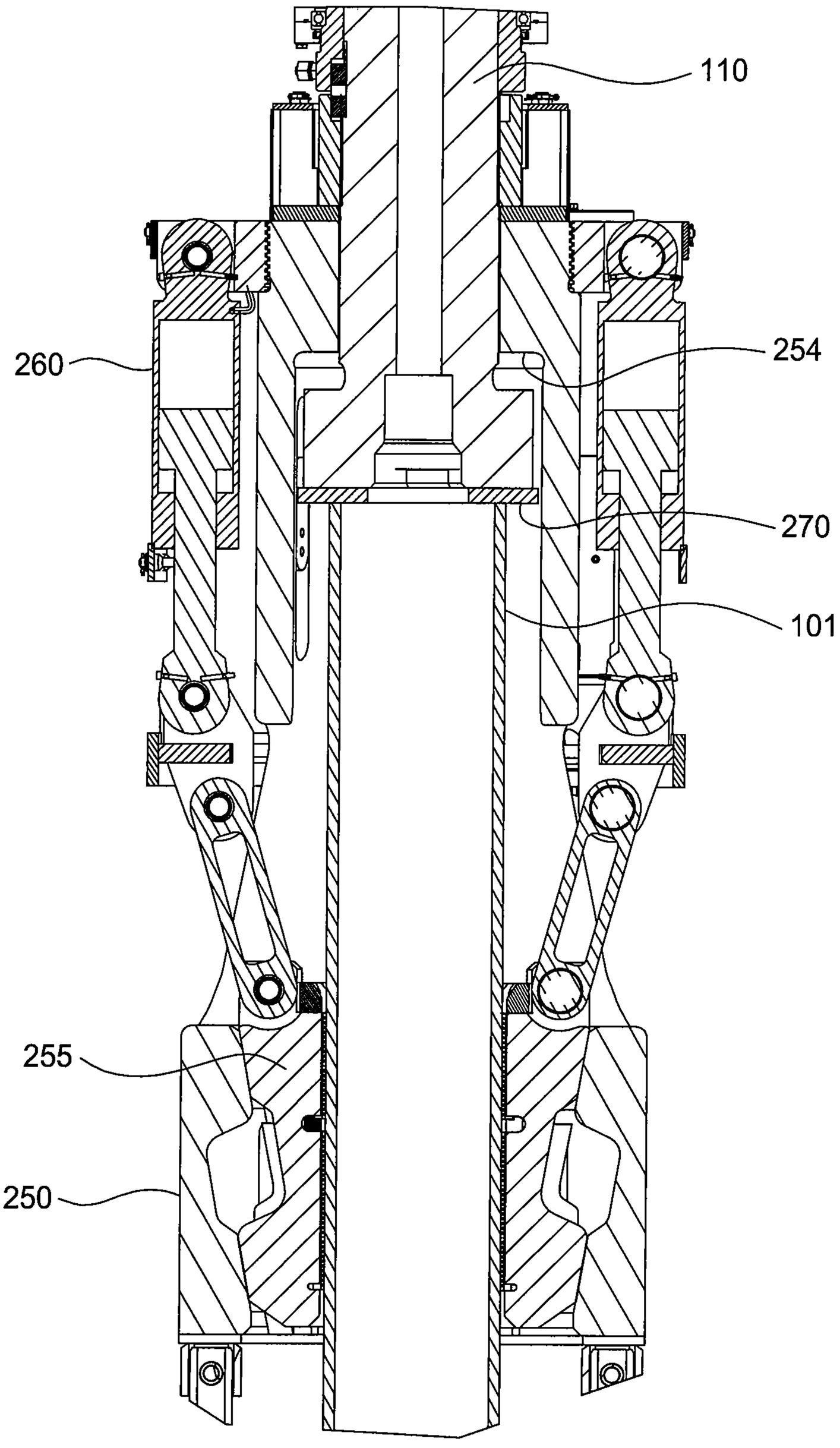

FIG. 11C

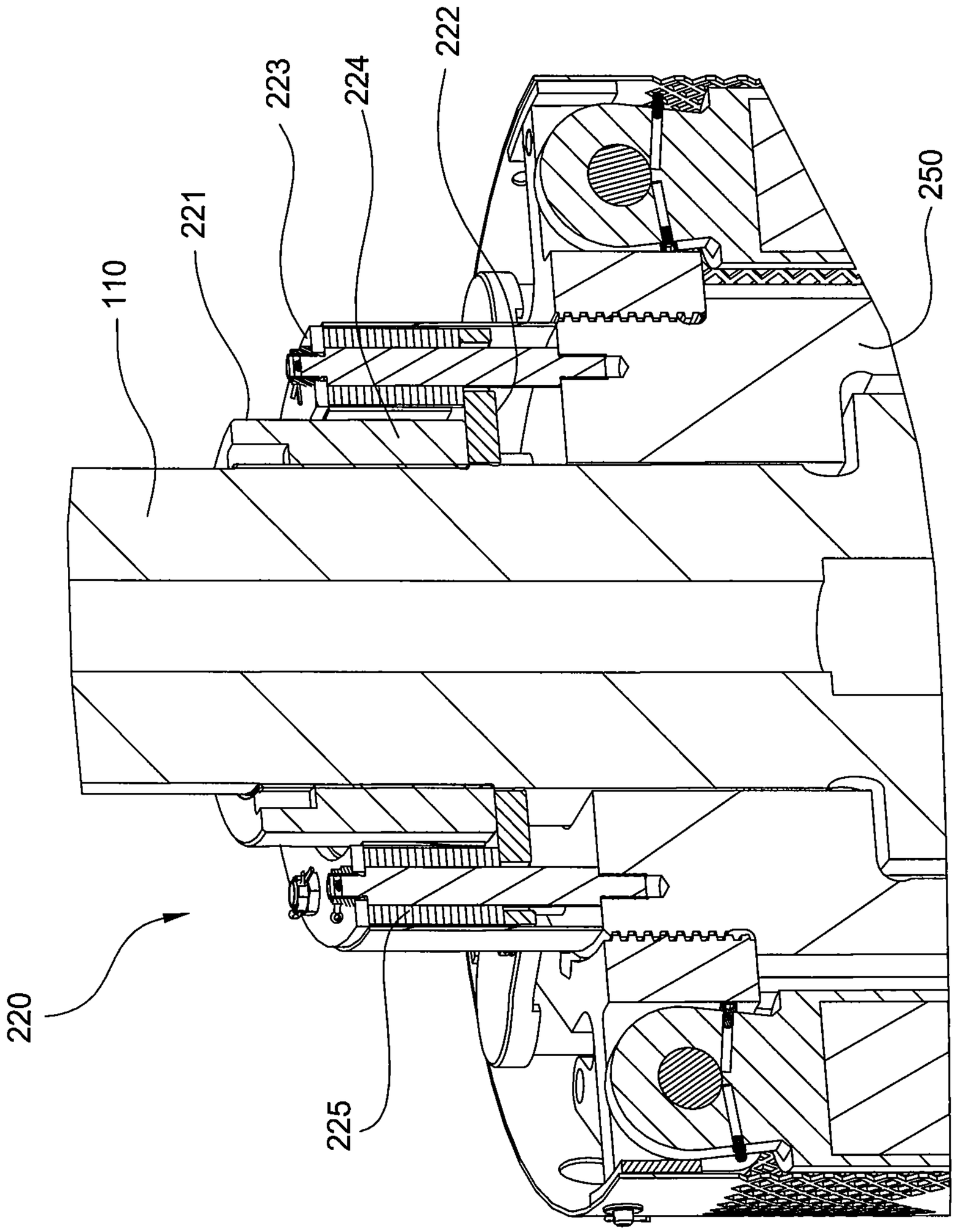

FIG. 11D

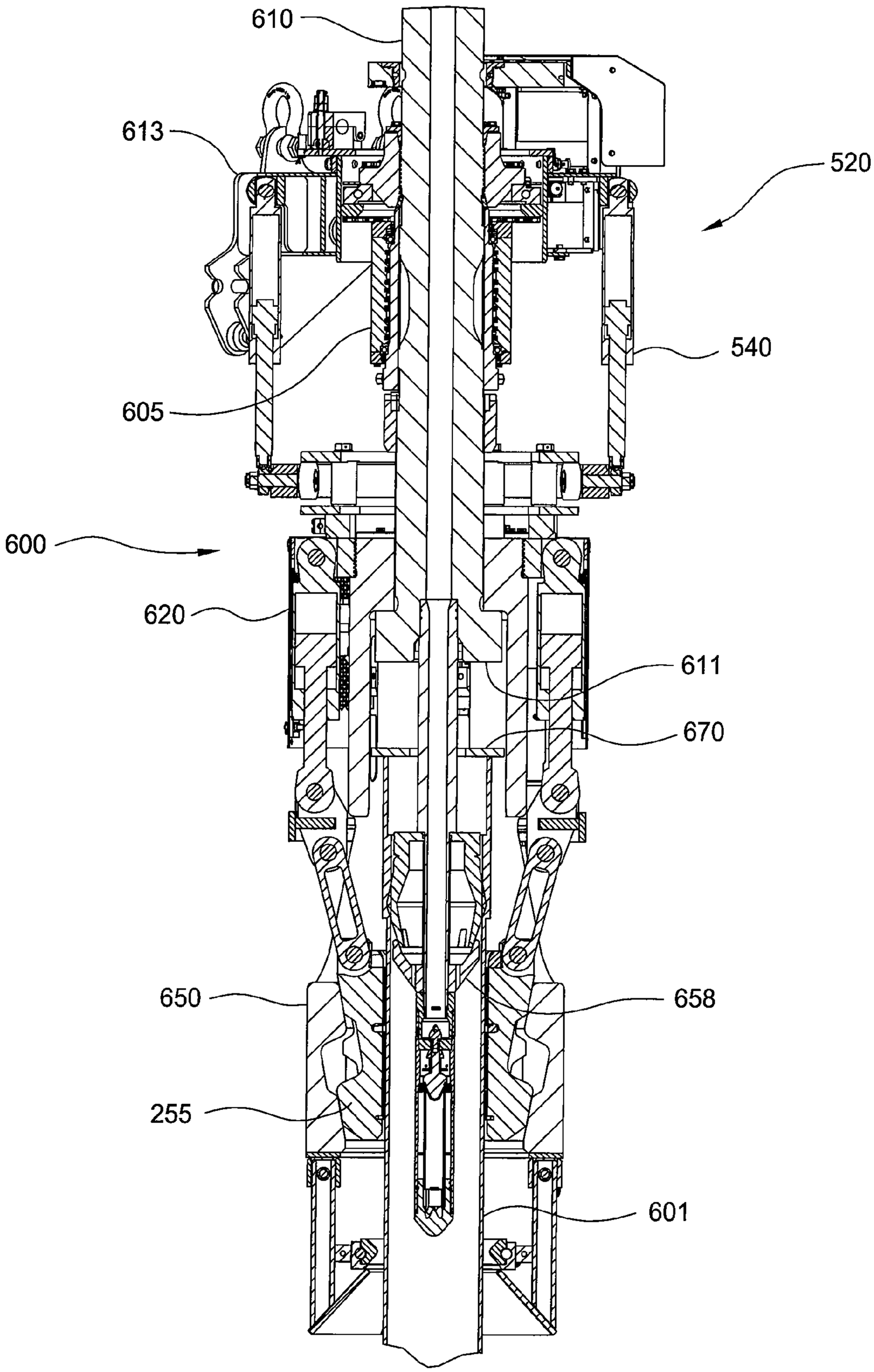

FIG. 12

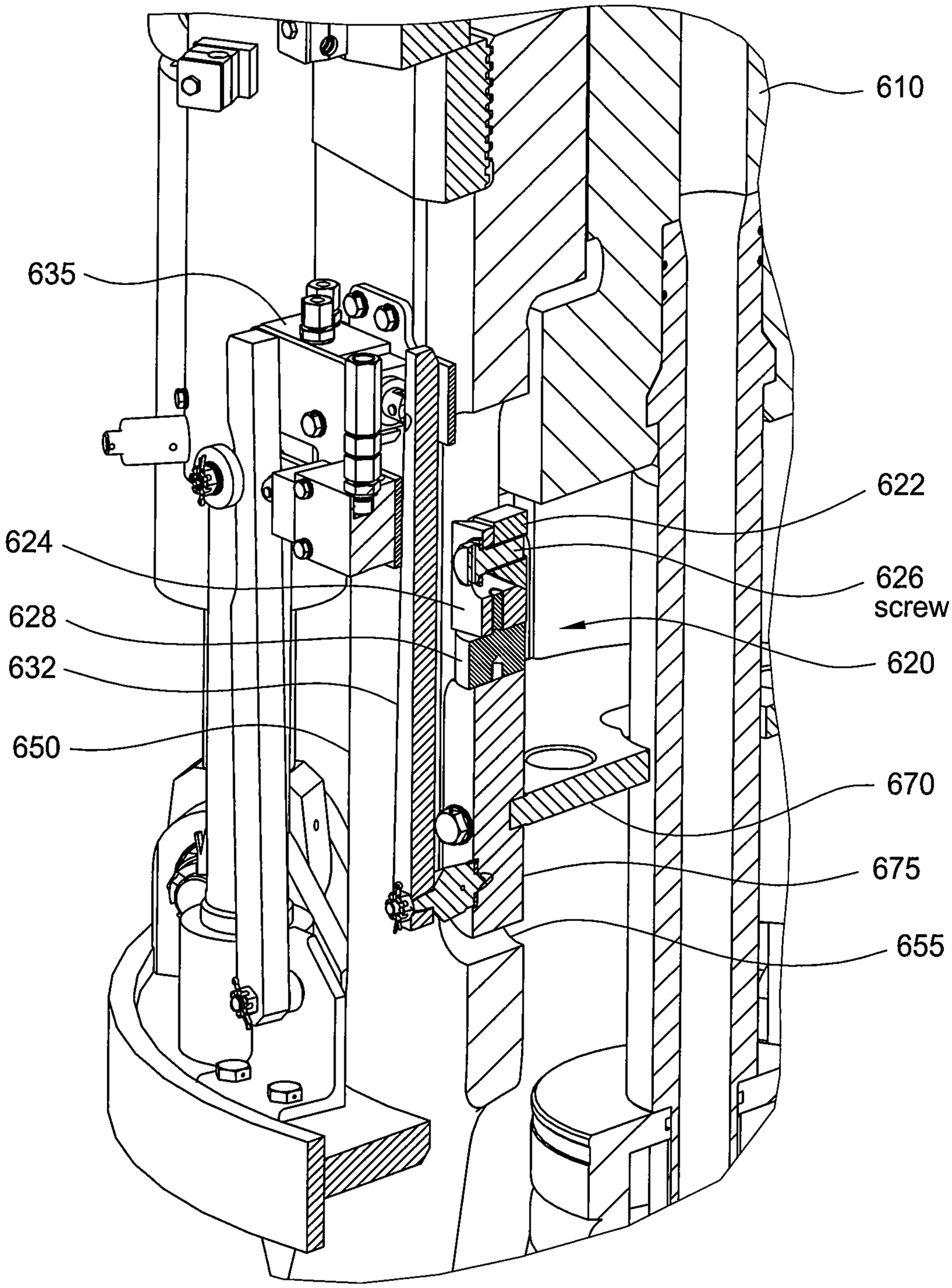

FIG. 13

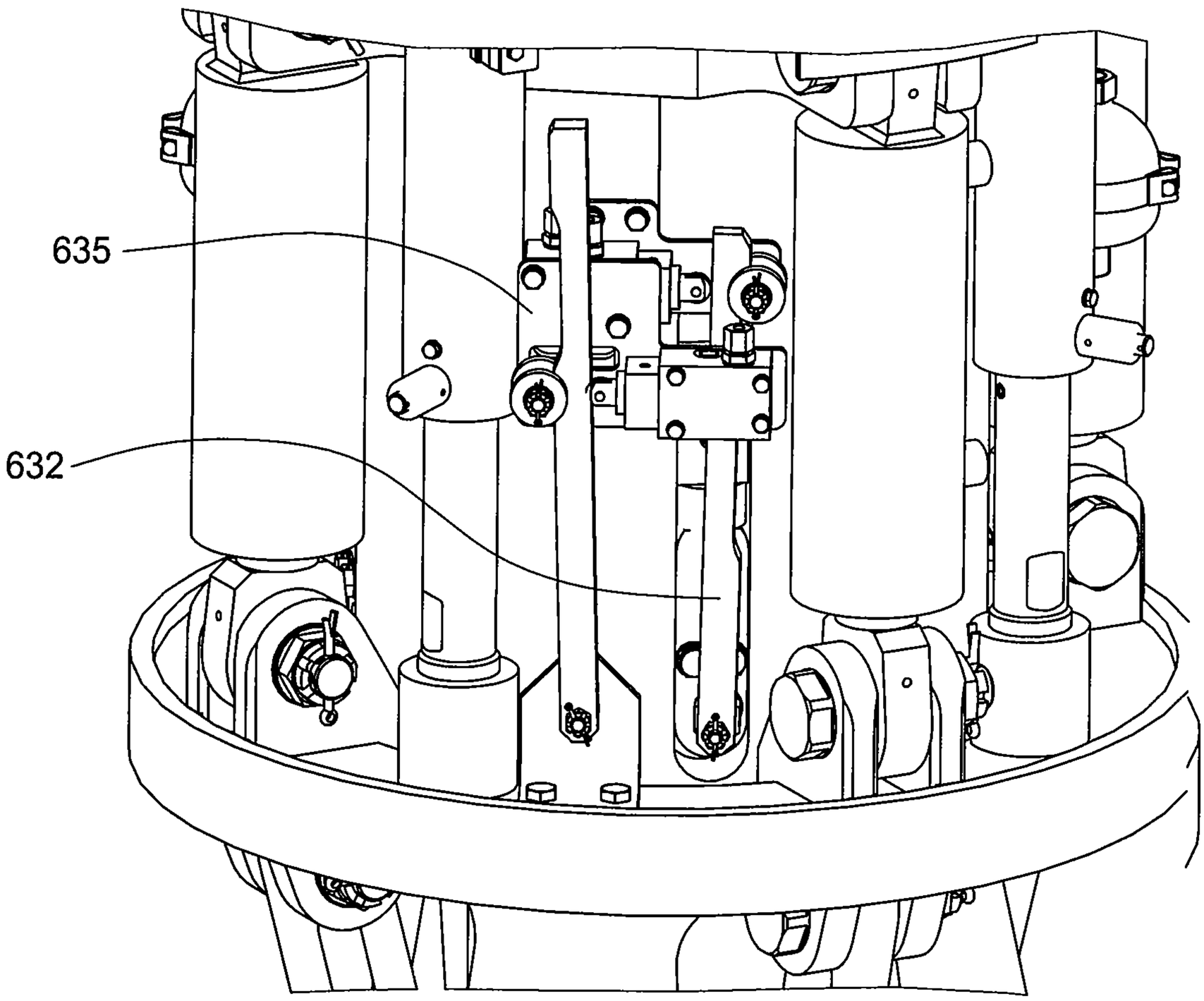

FIG. 14

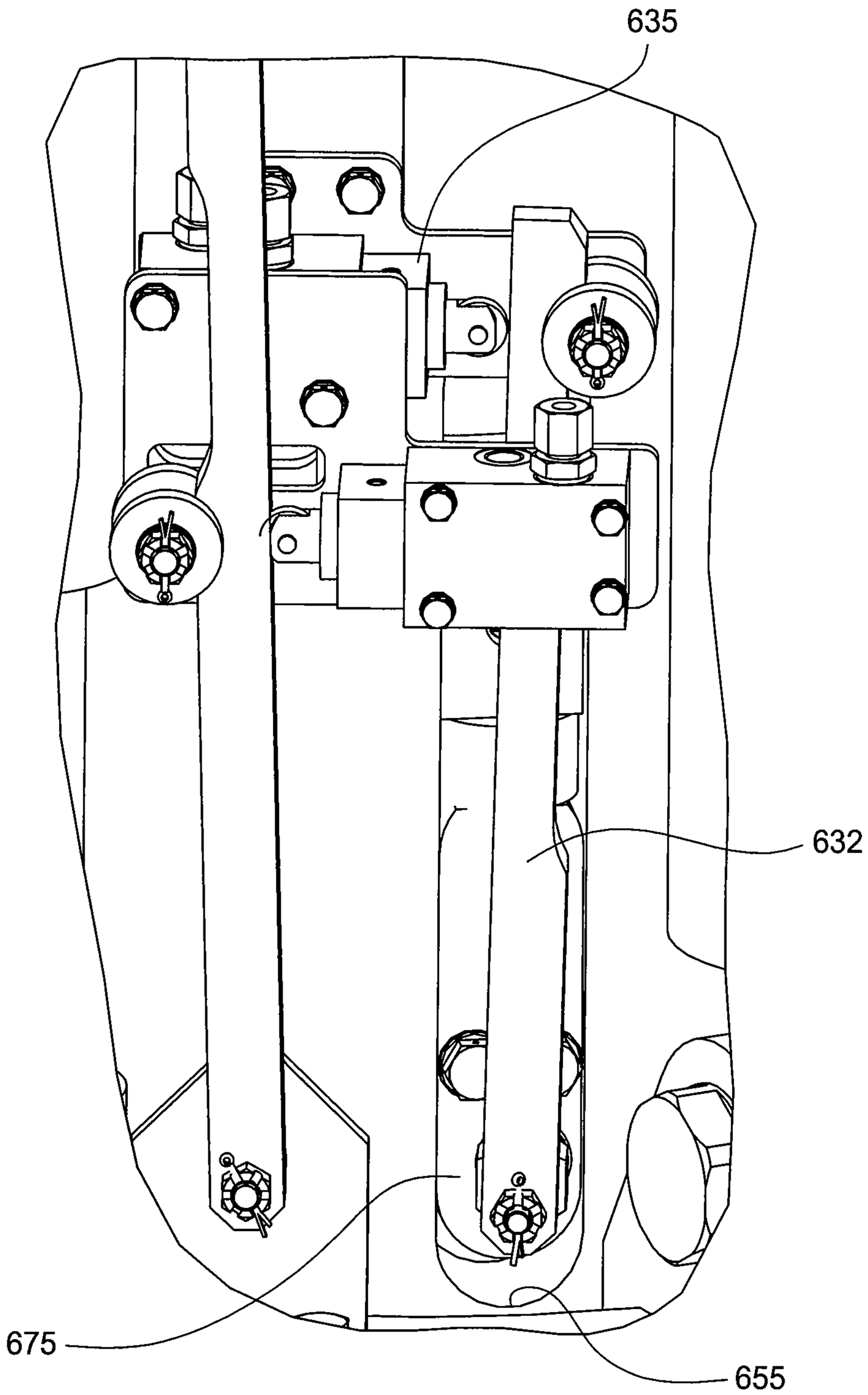

FIG. 15

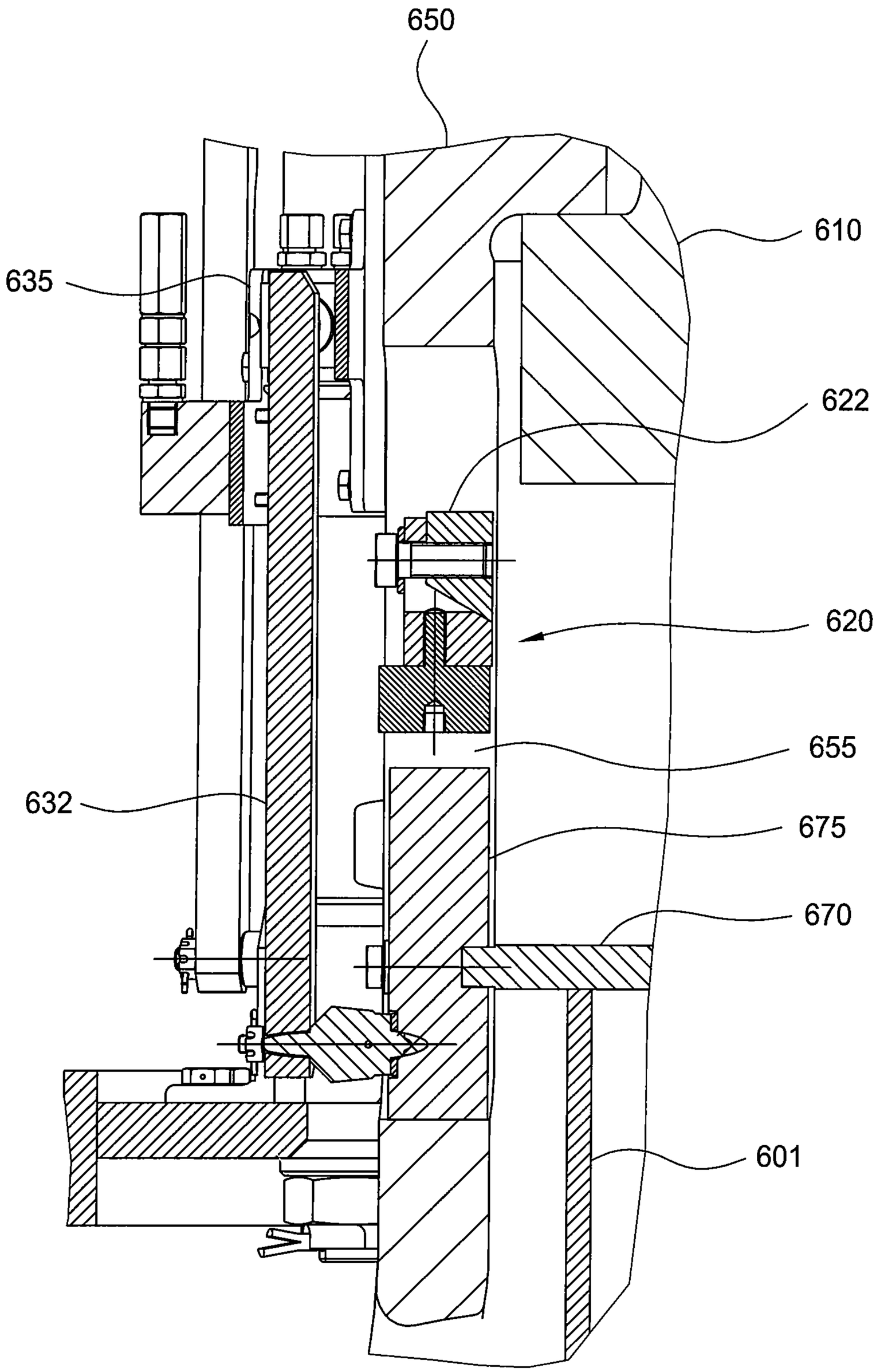

FIG. 16

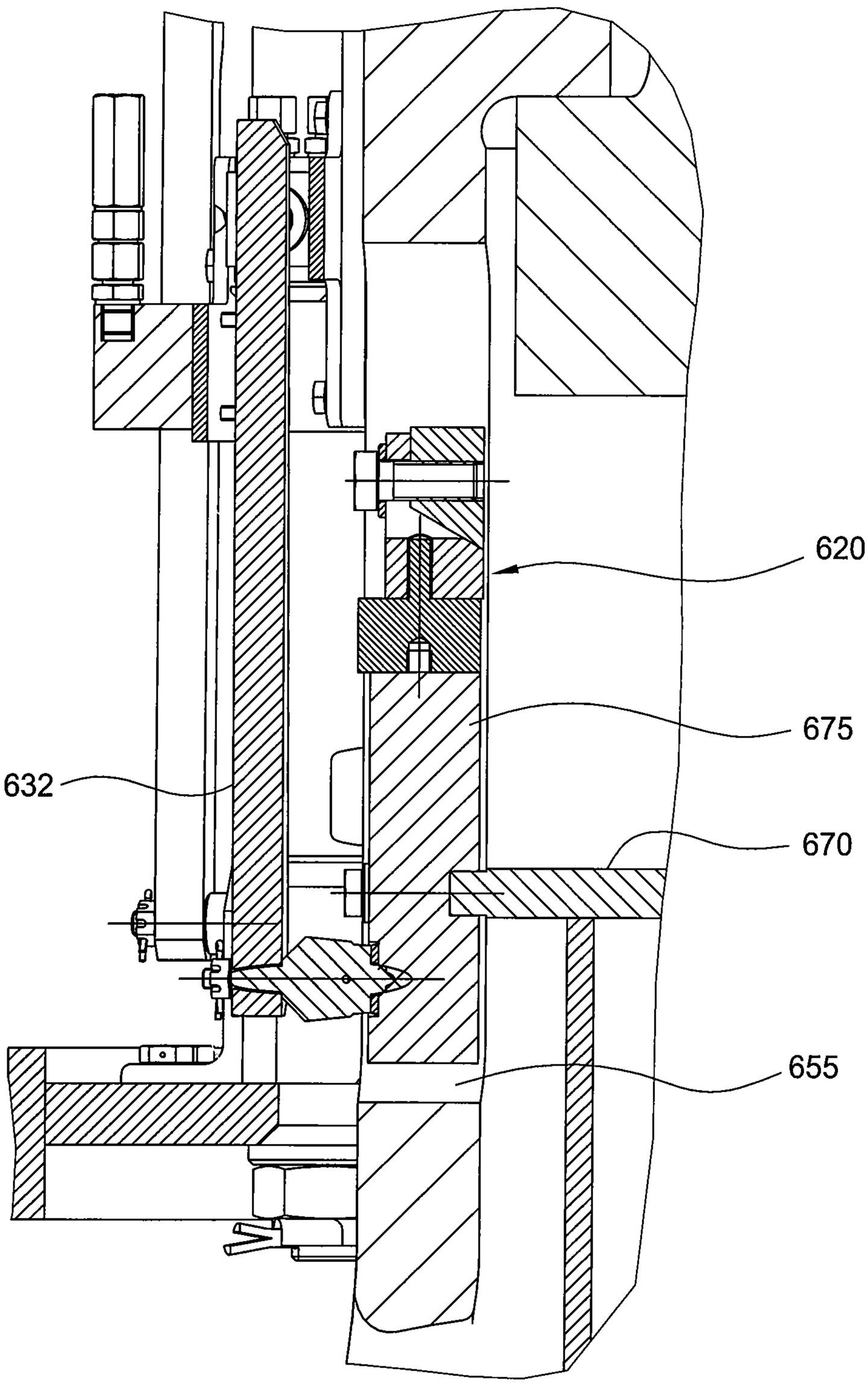

FIG. 17

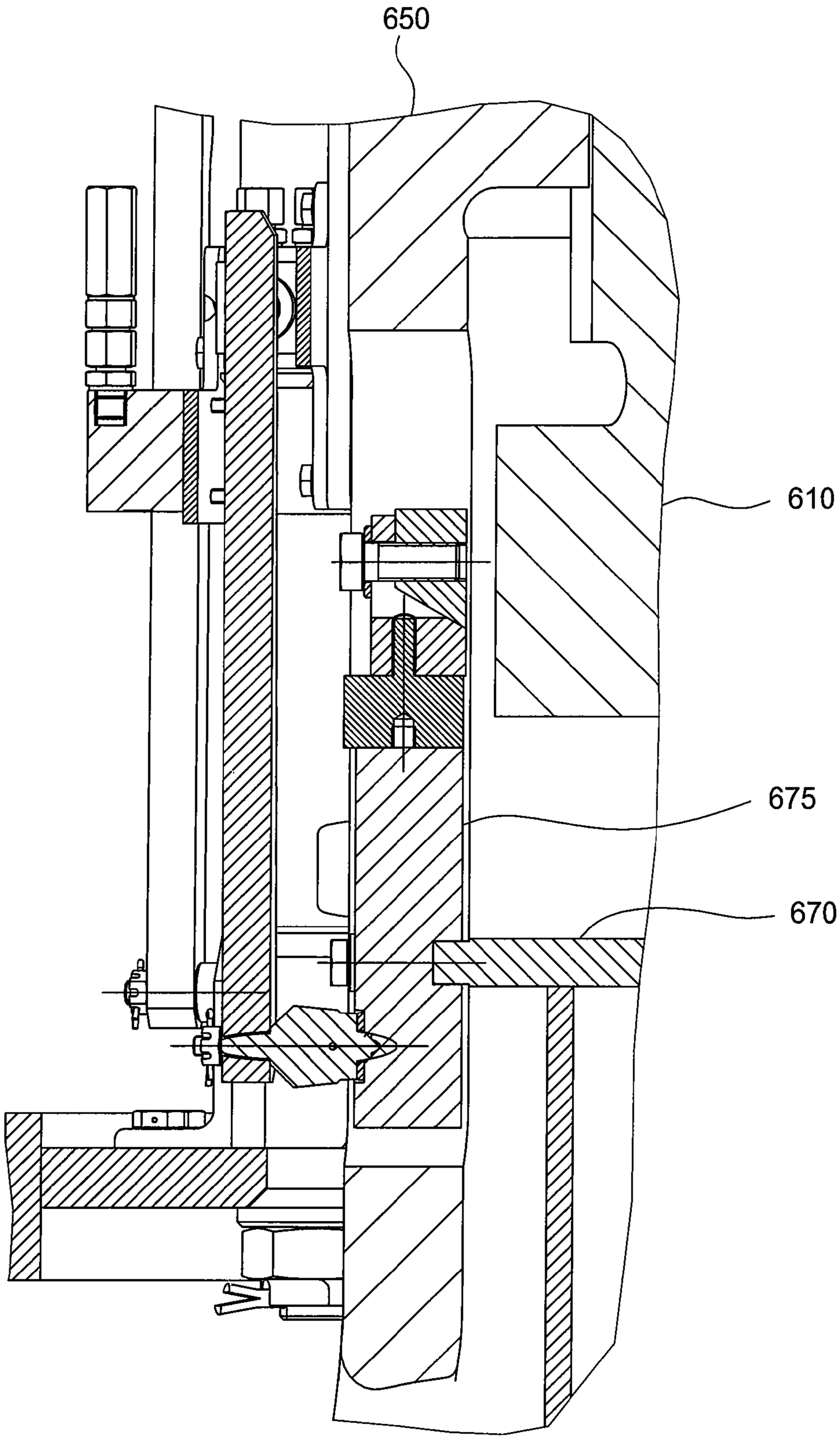

FIG. 18

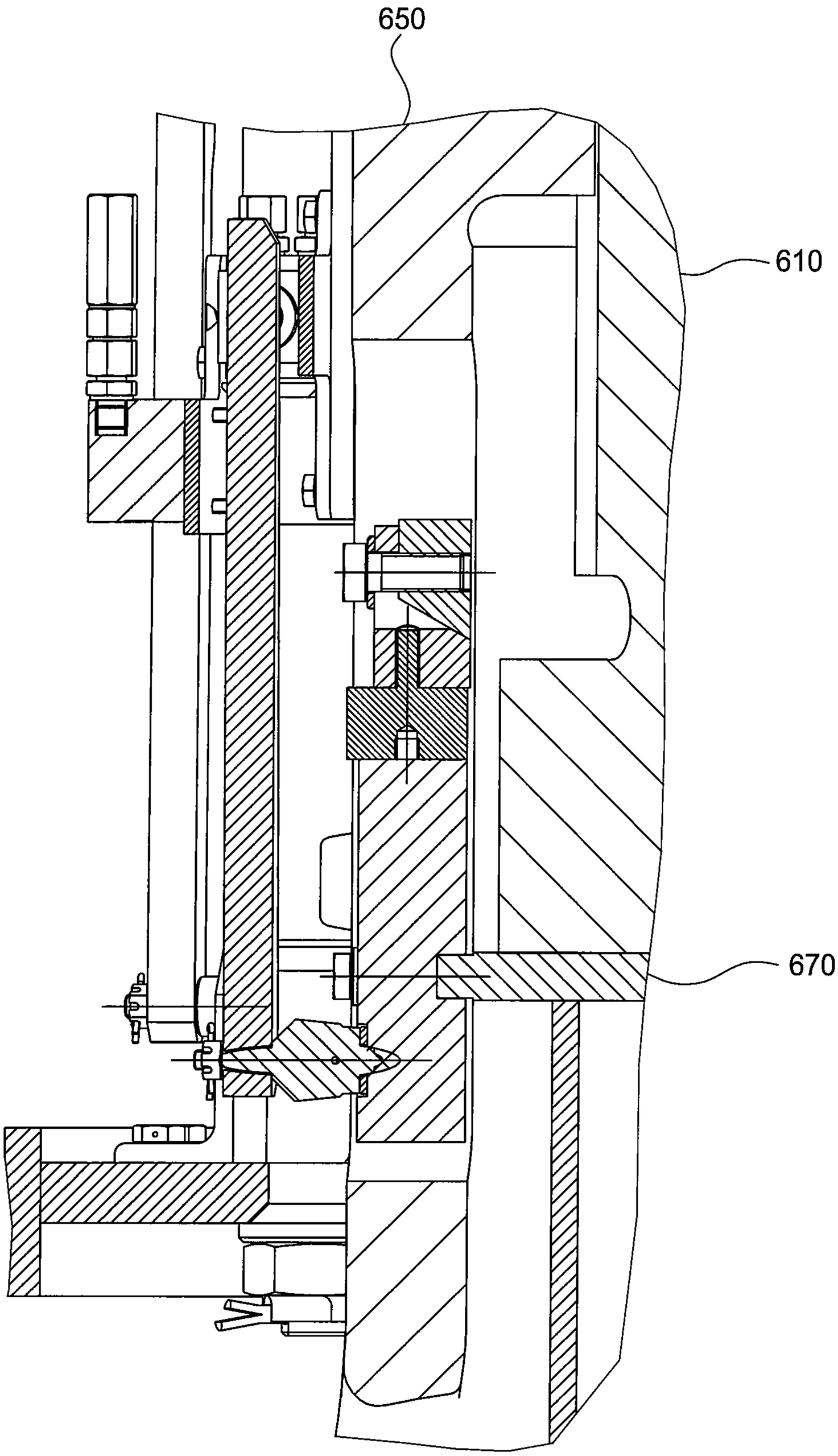

FIG. 19

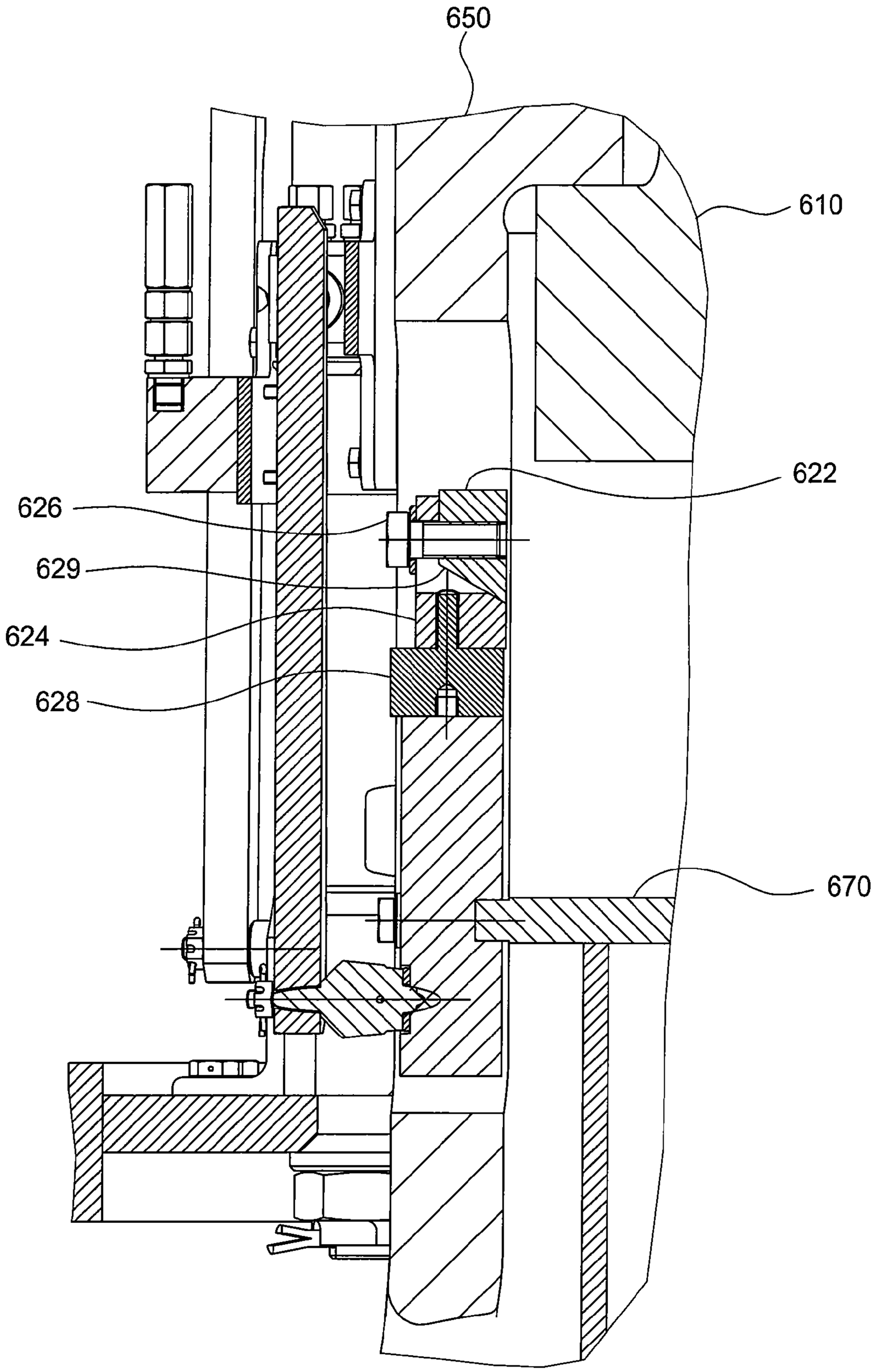

FIG. 20

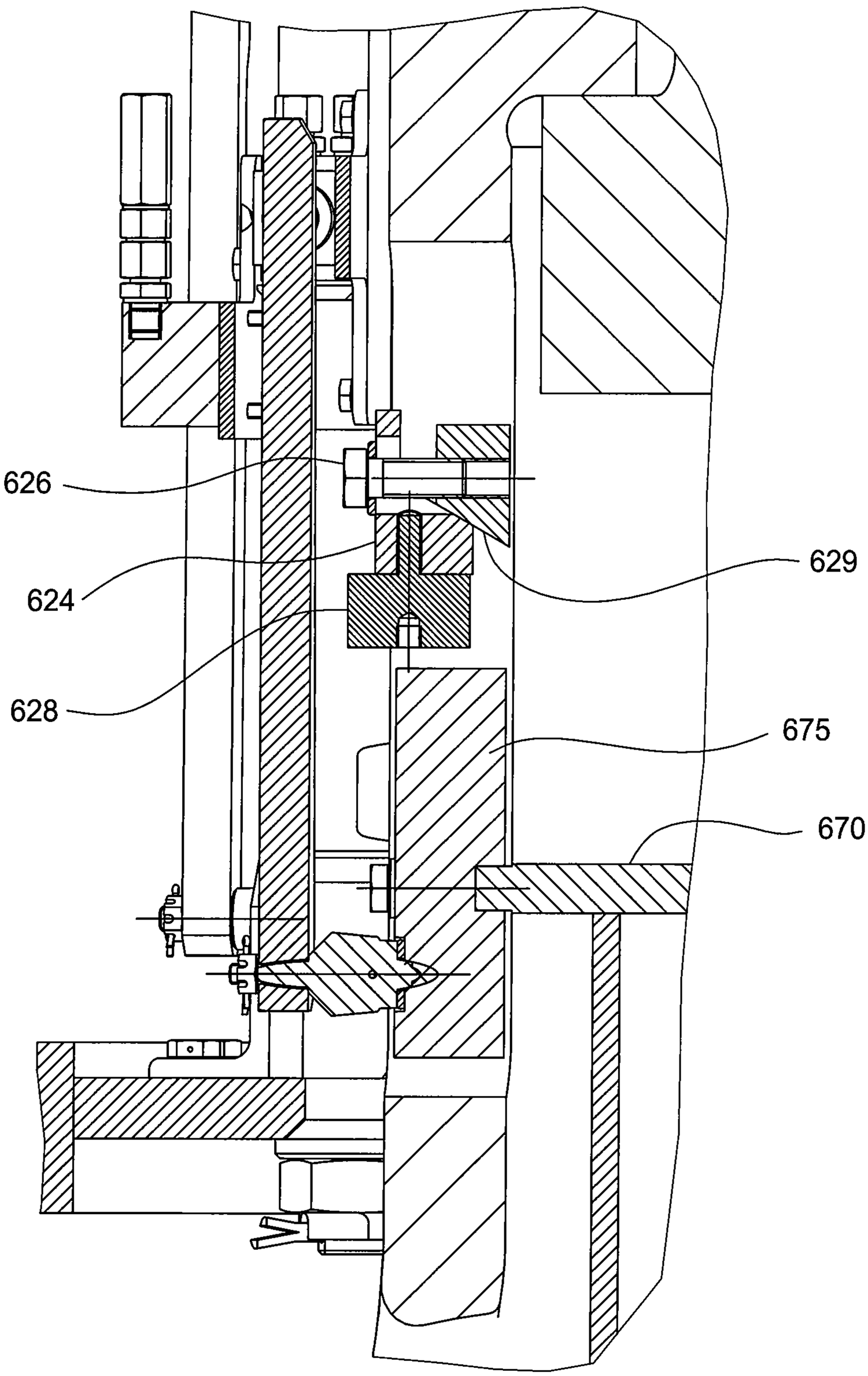

FIG. 21

APPARATUS AND METHODS FOR WEDGE LOCK PREVENTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

Embodiments of the present invention relate to methods and apparatus for handling tubulars using top drive systems. Particularly, the invention relates to methods and apparatus for engaging and disengaging a tubular handling apparatus from a tubular. More particularly still, the invention relates to a release mechanism for preventing the gripping elements of a tubular handling apparatus from locking during operations.

2. Description of the Related Art

It is known in the industry to use top drive systems to rotate a drill string to form a borehole. Top drive systems are equipped with a motor to provide torque for rotating the drilling string. The quill of the top drive is typically threadedly connected to an upper end of the drill pipe in order to transmit torque to the drill pipe. Top drives may also be used in a drilling with casing operation to rotate the casing.

In order to drill with casing, most existing top drives require a threaded crossover adapter to connect to the casing. This is because the quill of the top drives is not sized to connect with the threads of the casing. The crossover adapter is design to alleviate this problem. Typically, one end of the crossover adapter is designed to connect with the quill, while the other end is designed to connect with the casing.

In some instances, a tubular handling apparatus having movable gripping elements can be connected below the top drive to grip a tubular, such as casing, so that the tubular handling apparatus and the tubular may be driven axially or rotationally by the top drive. The tubular handling apparatus may be referred to as internal or external gripping tools depending on whether the tool grips an internal or external surface of the tubular.

Some of the tubular handling apparatus may use wedge type slips to grip the tubular. In the case of an internal gripping tool, the wedge slips are moved downward along a mating wedge surface to urge the wedge slips radially outward into contact with the interior surface of the tubular. To increase the gripping force on the tubular, the wedge slips may be provided with teeth on the gripping surface. Generally, the teeth are arranged to point up in order to prevent the tubular from sliding down. This arrangement allows the teeth to "bite" into the tubular in response to the weight of the tubular.

There is a need, therefore, for methods and apparatus for ensuring effective release of the wedge slips from the tubular.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide apparatus and methods for preventing or resolving a wedge lock condition. In one embodiment, the tubular handling apparatus is provided with a wedge lock release mechanism that creates a clearance to allow movement by the mandrel having mating wedge surfaces relative to the tubular to release the wedge slips.

In one embodiment, a release apparatus for releasing a gripping element of a tubular handling apparatus includes an anchor attached to the tubular handling apparatus; an engagement member for engaging the tubular; and an abutment device disposed between the anchor and the engagement member, wherein a distance between the anchor and the abutment device is adjustable to allow axial movement of the engagement member. In another embodiment, the abutment device is adjustable relative to the tubular gripping apparatus.

In another embodiment, a tubular handling apparatus for handling a tubular includes a mandrel; a carrier coupled to the mandrel; a gripping element for engaging the tubular; an engagement member for engaging an upper portion of the tubular; and an abutment device adapted to limit travel of the engagement member, wherein a length of the abutment device is adjustable to allow movement of the engagement member. In yet another embodiment, the tubular handling apparatus includes an anchor attached to the carrier. In yet another embodiment, the abutment device is adjustable relative to the anchor.

In another embodiment, a method of releasing from a wedge lock condition during a tubular handling operation includes providing a tubular handling apparatus having a mandrel, a gripping element movable along the mandrel, and an engagement member for contacting a tubular and attaching a release mechanism to the mandrel, wherein the release mechanism includes an anchor and an abutment device axially movable relative to the anchor. The method also includes engaging the tubular to the engagement member and the engagement member to the abutment device; moving the abutment device away from the tubular; moving the mandrel relative to the engagement member; and releasing the gripping element.

In another embodiment, a release apparatus for releasing a gripping element of a tubular handling apparatus includes an anchor attached to the tubular handling apparatus and an engagement member for engaging the tubular, wherein the position of the engagement member relative to the anchor is selectively adjustable to allow for relative axial movement between the anchor and the tubular.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

FIG. **1** is a cross-sectional view of an exemplary internal gripping tool.

FIG. **2** is an enlarged view of an exemplary hydraulic actuator.

FIG. **3** shows an exemplary wedge lock release mechanism using a height adjustable stop member.

FIG. **4** shows the wedge lock release mechanism of FIG. **3** during normal operations.

FIG. **5** shows the wedge lock release mechanism of FIG. **3** activated to resolve a wedge lock condition.

FIGS. **6**A-**6**C illustrates another embodiment of a wedge lock release mechanism having a tapered ring. FIG. **6**A is a perspective view of the wedge lock release mechanism.

FIG. **6**B shows the wedge lock release mechanism of FIG. **6**A during normal operations.

FIG. **6**C shows the wedge lock release mechanism of FIG. **6**A activated to resolve a wedge lock condition.

FIGS. **7**A-C illustrate another embodiment of a wedge lock release mechanism having a ball ring. FIG. **7**A is a perspective view of the wedge lock release mechanism.

FIGS. **7**B and **7**B**1** show the wedge lock release mechanism of FIG. **7**A during normal operations.

FIGS. **7**C and **7**C**1** show the wedge lock release mechanism of FIG. **7**A activated to resolve a wedge lock condition.

FIGS. **7**D and **7**D**1** show another embodiment of a wedge lock release mechanism during normal operations.

FIGS. **7**E and **7**E**1** show the wedge lock release mechanism of FIG. **7**D activated to resolve a wedge lock condition.

FIGS. **8**A-**8**E illustrate another embodiment of a wedge lock release mechanism having an eccentric bolt. FIG. **8**A is a perspective view of the wedge lock release mechanism.

FIG. **8**B shows the wedge lock release mechanism of FIG. **8**A during normal operations.

FIG. **8**C shows the wedge lock release mechanism of FIG. **8**A activated to resolve a wedge lock condition.

FIG. **8**D is a perspective view of a bolt of the wedge lock release mechanism of FIG. **8**A. FIG. **8**E is a front view of the bolt of FIG. **8**D.

FIG. **9**A shows another embodiment of a wedge lock release mechanism of during normal operations.

FIG. **9**B shows the wedge lock release mechanism of FIG. **9**A activated to resolve a wedge lock condition.

FIG. **10**A shows another embodiment of a wedge lock release mechanism of during normal operations.

FIG. **10**B shows the wedge lock release mechanism of FIG. **10**A activated to resolve a wedge lock condition.

FIGS. **11**A-**11**D illustrate another embodiment of a wedge release mechanism usable with an external gripping tool. FIG. **11**A shows the external gripping tool in an unclamped position. FIG. **11**B shows the external gripping tool in a clamped position. FIG. **11**C shows the external gripping tool applying a downward force on the tubular. FIG. **11**D shows an embodiment of a thread compensator.

FIG. **12** shows another embodiment of a tubular handling apparatus.

FIG. **13** shows another embodiment of a wedge lock release mechanism installed on the tubular handling apparatus of FIG. **12**.

FIG. **14** is a partial perspective view of the tubular handling apparatus of FIG. **12**.

FIG. **15** is a partial exploded view of FIG. **14**.

FIGS. **16-19** are partial exploded views of the tubular handling apparatus in operation. FIG. **16** shows the tubular handling apparatus being lowered until the bumper plate engages the casing. FIG. **17** shows the tubular handling apparatus being lowered further. FIG. **18** shows the mandrel relative to the carrier after the lowering of the tubular handling apparatus has stopped. FIG. **19** shows the mandrel is contacting the bumper plate.

FIG. **20** shows the wedge lock release mechanism of FIG. **13** in the unreleased position.

FIG. **21** shows the wedge lock release mechanism of FIG. **13** in the released position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Tubular handling apparatus may use wedge type slips to grip the tubular. To release the tubular, the wedge slips are retracted along the mating wedge surface to urge the wedge slips radially inward. However, the retraction may cause teeth on the wedge slips to bite into the tubular because the wedge slips are pulled in direction of the teeth. Therefore, it is often desired to move the mandrel containing mating wedge surface slightly downward relative to the tubular before retracting the wedge slips.

A problem may arise when the tubular handling apparatus is equipped with a coupling engagement member such as an engagement plate. In some cases, the engagement plate is fixed to the mandrel of the gripping tool to limit the depth of the insertion of the internal gripping tool into the tubular. If the coupling abuts the engagement plate, the mandrel can no longer be moved downward to facilitate the release of the wedge slips. The wedge slips are thus locked from release.

Embodiments of the present invention generally relate to a release mechanism for preventing the gripping elements of a tubular handling apparatus from locking during operations. In all embodiments, the tools described herein may be connected to a top drive, such that rotation of the top drive rotates the tool and the tubulars that are gripped by the tool. To better understand the novelty of the system of the present invention and the methods of use thereof, reference is hereafter made to the accompanying drawings.

FIG. **1** is a cross-sectional view of an exemplary internal gripping tool **100**. The internal gripping tool includes the mandrel **110**, gripping elements **155**, and a hydraulic actuator **160** for actuating the gripping elements **155**. As shown, the gripping elements **155** are wedge type slips disposed on a mating wedge surface of the mandrel **110**. Axial movement of the slips relative to the mandrel **110** urges the slips to move radially outward or inward. The internal gripping tool **100** may optionally be equipped with a fill-up tool **158**.

FIG. **2** is an enlarged view of an exemplary hydraulic actuator **160**. The actuator **160** includes a housing **162** having a threaded connection to the mandrel **110**. The housing **162** may also be secured to the mandrel **110** using a spline connection **161**. One or more actuator cylinders **164** attached to the housing **162** using bolts **163** are coupled to an actuator pipe **165**. The actuator pipe **165** is connected to the gripping elements **155**. Activation of the actuator cylinder **164** urges the axial movement of the actuator pipe **165**. In turn, the actuator pipe **165** moves the gripping elements **155** relative to the mandrel **110**. A coupling engagement plate **170** (also referred to as a "Bumper Plate") may be coupled to the hydraulic actuator **160**. Contact with the casing coupling may cause axial movement of the engagement plate **170**. A stop member **178** is provided to limit the travel of the engagement plate **170**. Although embodiments of the wedge lock release mechanism will be discussed with reference to the internal gripping tool, it is contemplated that the wedge lock release mechanisms are suitable for use with an external gripping tool. Exemplary suitable internal or external gripping tools are disclosed in U.S. patent application Ser. No. 12/435,346, filed on May 4, 2009, entitled "Tubular Handling Apparatus" by M. Liess, et al., which application is incorporated herein by reference in its entirety.

FIG. **3** shows an exemplary wedge lock release mechanism using a height adjustable stop member. As shown, the mandrel **110** and the gripping elements **155** are disposed in the tubular **102** and the gripping elements **155** have been actuated into engagement with the tubular **102**. In this position, the actuator pipe **165** has extended the gripping elements **155** along the mating wedge surfaces of the mandrel **110**, thereby extending the gripping elements **155** radially outward into engagement with tubular **102**. A stop member **178** is connected to an anchor **310** for attachment to the mandrel **110**. Alternatively, the anchor **310** may be attached to the housing **162** of the hydraulic actuator **160**, which in turn is attached to the mandrel **110**. In FIGS. **3-5**, the stop member **178** is a screw that is attached to the anchor **310**. The screw has a first length extending from the anchor **310**. The engagement plate **170** is positioned at a distance away from the end of the stop member **178** and is movable relative to the stop member **178**. In one embodiment, the engagement plate **170** is biased away from the anchor **310** using a biasing member such as a spring. As shown, the coupling **101** of the tubular **102** is in contact with the engagement plate **170**. The clearance between the engagement plate **170** and the stop member **178** exists under standard

operating conditions. The clearance allows the mandrel **110** to move relative to the gripping elements **155** to release the gripping elements **155**.

In some instances, it may be desirable to apply a downward force on the tubular **102**. Application of this force may cause the mandrel **110** and the wedge slips to slide down relative to the tubular **102**. This relative movement causes the stop member **178** to contact engagement plate **170**, thereby eliminating the clearance, as illustrated in FIG. **4**. As a result, the mandrel **110** is prevented from moving downward relative to the tubular **102**, and thus, locking the gripping elements **155** from release.

When this condition occurs, the stop member **178** may be adjusted to create a clearance. As shown in FIG. **5**, the screw may be released to adjust the height of the screw extending from the anchor **310**. For example, the screw may be rotated to retract from the engagement plate **170**. In this respect, a clearance is created to allow the mandrel **110** to move axially relative to the tubular **102** to facilitate the release of the gripping elements **155**. In another embodiment, stop member may be a bolt, pin, a retractable elongated member, or other suitable height adjustable stop member. It is also contemplated that the stop member is removable. In this respect, if the wedge lock condition occurs, the stop member may be removed to create the clearance.

FIGS. **6**A-**6**C illustrates another embodiment of a wedge lock release mechanism **320**. In this embodiment, the wedge lock release mechanism **320** has a ring shaped anchor **321** attached to the mandrel **110** using a spline connection. The anchor **321** may be secured to the mandrel **110** using radially inserted pins or screws. The tubular coupling engagement member **323** is also ring shaped and is coupled to the anchor **321** using a guide rod **324**. The guide rod **324** allows the engagement member **323** to move axially relative to the anchor **321**. A tapered ring **325** is disposed between the engagement member **323** and the anchor **321**. The upper and lower contact surfaces of the tapered ring **325** have alternating tapers that mate with complementary taper surfaces on the anchor **321** and the engagement member **323**. Each taper may have a crest **327** and a recess **326**. FIG. **6**B shows the release mechanism **320** at normal operating height. The crest **327** of the tapered ring **325** is engaged with a corresponding crest **327** of the anchor **321** or the engagement plate **323**.

FIG. **6**B presents a wedge lock condition in which the coupling **101** is contacting the engagement member **323**. In turn, the engagement member **323** is in contact with the tapered ring **325**, which is in contact with the anchor **321**. In this respect, a clearance does not exist to allow the mandrel **110** to move relative to the coupling **101**, and thus, presenting a wedge lock condition. To release the wedge lock, the tapered ring **325** may be rotated, in this embodiment, to the left of the anchor **321** and the engagement member **323**, such that the crest **327** of the taper surface of the tapered ring **325** mates with a corresponding recess **326** of the taper surface on the anchor **321** or the engagement member **323**, as shown in FIG. **6**C. In this respect, the overall height of the release mechanism **320** may be reduced, thereby creating the clearance for movement of the mandrel **110** to release the gripping elements **155**. In another embodiment, the release mechanism **320** has an anchor coupled directly to the engagement member. The height of the release mechanism is adjustable by rotating either the anchor or the engagement member. In yet another embodiment, the tapered ring only one tapered surface for engagement with the anchor **321** or the engagement member **323**.

FIGS. **7**A-C illustrate another embodiment of a wedge lock release mechanism **330**. In this embodiment, the wedge lock release mechanism **330** has a ring shaped anchor **331** attached to the mandrel **110** using a spline connection. The anchor **331** may be secured to the mandrel **110** using radially inserted pins or screws. The coupling engagement member **333** is also ring shaped and is coupled to the anchor **331** using a guide rod **334**. The guide rod **334** allows the engagement member **333** to move axially relative to the anchor **331**. A ball ring **335** is disposed between the engagement member **333** and the anchor **331**. A first set of balls **337** may be disposed between the engagement member **333** and the ball ring **335** to facilitate relative movement therebetween. A lower groove **338** for retaining the balls may be formed on the engagement member **333** and/or the ring **335**. A second set of balls **337** may be disposed between the anchor **321** and the ring **335**. The upper groove **336** on the ball ring **335** may be segmented such that each segment **336** is retaining one ball. Each groove segment **336** may have a pocket **332** disposed at an end of the groove segment **336**. The pocket **332** is recessed from the groove segment **336** such that a ball in the pocket **332** is at a lower height than a ball in the groove segment **336**. The anchor **331** may have a circular groove for interacting with the balls **337** in the groove segment **336**. FIGS. **7**B and **7**B**1** show the release mechanism **330** under normal operating height. As shown, the balls **337** between the ball ring **335** and the anchor **321** are disposed in the groove segment **336**, not the pocket **332**.

FIG. **7**B presents a wedge lock condition in which the coupling **101** is contacting the engagement member **333**. In turn, the engagement member **333** is in contact with the ball ring **335**, which is in contact with the anchor **331** via the balls **337**. In this respect, a clearance does not exist to allow the mandrel **110** to move relative to the coupling **101**. To release the wedge lock, the ball ring **335** may be rotated, in this embodiment, to the left, such that the balls **337** between the ring **325** and the anchor **321** are moved from the groove segment **336** and disposed in one or more pockets **332**, as shown in FIGS. **7**C and **7**C**1**. With the balls **337** sitting in the pocket **332**, the overall height of the release mechanism **330** is reduced, thereby creating the clearance for movement of the mandrel **110** to release the gripping elements **155**. In addition or alternatively, groove segments may be formed between the ball ring **335** and the engagement member **333**.

FIGS. **7**D and **7**D**1** show another embodiment of the wedge lock release mechanism. The release mechanism may include a spring **338** adapted to push the ball **337** out of the pocket **332**, thereby returning the ball **337** to the top position on the groove segment **336**. FIGS. **7**D and **7**D**1** show the ball **337** in the groove segment **337** and the spring **338** in the extended position. FIG. **7**D also presents a wedge lock condition. To resolve the wedge lock condition, the ball ring **335** is rotated to move the balls **337** into the pocket **332**. As seen in FIGS. **7**E and **7**E**1**, the balls **337** are sitting in the pocket **332** and have compressed the spring **338**, thereby reducing the height of the release mechanism. The decrease in height creates a clearance between engagement member **333** and the coupling **101** to facilitate the release of the gripping elements.

FIGS. **8**A-D illustrate another embodiment of a wedge lock release mechanism **340**. In this embodiment, the wedge lock release mechanism **340** has a ring shaped anchor **341** attached to the mandrel **110** using a spline connection. The anchor **341** may be secured to the mandrel **110** using radially inserted pins or screws. A coupling engagement member **343** is also ring shaped and is coupled to the anchor **341** using a guide rod **344**. The guide rod **344** allows the engagement member **343** to move axially relative to the anchor **341**. A plurality of eccentric bolts **345** are rotatably coupled to the anchor **341**. Each bolt **345** has a first end and a second end rotatably

coupled to the anchor **341** and may act as axles for the bolt **345**. The body **348** between the two ends has an eccentric cross-section. In one embodiment, the body **348** has a first cross-sectional thickness **346** that is greater than a second thickness **347**, as illustrated in FIG. **8**E. As shown, the body **348** has an arcuate shape that extends over **180** degrees. The two ends of the arcuate shaped are connected by a flat surface. During normal operations, the bolt **345** is positioned such that the longer first thickness **346** is aligned with the axis of the tubular and that the dimension of the first thickness **347** is selected so that a lower end of the first thickness **346** extends below the anchor **341**, as illustrated in FIG. **8**B. In this respect, the engagement member **343** would contact the bolt **345** instead of the anchor **341**, thereby providing a clearance between the anchor **341** and the engagement member **343**. The dimension of the shorter second thickness **347** may be selected such that when the bolt **345** is rotated to move the shorter second thickness **347** in axial alignment with the tubular, the engagement member **343** may directly contact the anchor **341**, as illustrated in FIG. **8**C.

FIG. **8**B presents a wedge lock condition in which the coupling **101** is in contact with the engagement member **343**. As show, the coupling **101** is in contact with the engagement member **343**, which is in contact with the bolt **345**. A clearance does not exist to allow the mandrel **110** to move relative to the coupling **101**. To release the wedge lock, the bolts **345** may be rotated such that the shorter second side is in the axial position. In this embodiment, the bolts **345** are rotated such that the flat surface is facing the engagement member **343**, as shown in FIG. **8**C. In this respect, the engagement member **343** is allowed to move closer toward the anchor **341**, thereby reducing the overall height of the release mechanism **340**. In this manner, a clearance between the engagement member **343** and the coupling **101** may be created for movement of the mandrel **110** to release the wedge.

FIGS. **9**A-**9**B illustrate another embodiment of a wedge release mechanism. In this embodiment, the wedge lock release mechanism is a piston and cylinder assembly **350** attached to the mandrel **110**. The piston **351** is attached to the anchor **352**, and the cylinder **354** is attached to the engagement plate **353**. Alternatively, the lower portion of the cylinder may act as the engagement plate. A fluid path **355** exists to introduce or release a fluid in the fluid chamber of the cylinder **354**. In one embodiment, the fluid path **355** may be connected to the release line **356** of the cylinder **164**. As shown in FIG. **9**A, the cylinder **354** is in the extended position and is locked by a check valve **357**. A clearance is not present to allow the release of the gripping elements **155**. To release the wedge lock, fluid in the cylinder **354** is relieved through the check valve **357**. This allows the cylinder **354** and the engagement plate **353** to move upward to provide a clearance to release the gripping elements **155**, as shown in FIG. **9**B. It can be seen in FIG. **9**B that the fluid chamber has decreased in size. In another embodiment, the check valve **357** may be opened by the release of the clamping cylinders **164**. Initially, the clamping cylinder is released to retract the gripping elements **155** and tubular **102** against the engagement plate **353**. Because fluid path **355** is in communication with the release line **356**, the pressure inside the release line **356** opens the check valve **357**. It is contemplated that one or more piston and cylinder assemblies may be positioned around the mandrel. It is also contemplated that the cylinder may be an annular cylinder around the mandrel. It is further contemplated the cylinder is attached to the anchor and the piston is attached to the engagement plate.

FIGS. **10**A-**10**B illustrate another embodiment of a wedge release mechanism. In this embodiment, the wedge lock release mechanism is a piston and cylinder assembly **360** attached to the mandrel **110**. The piston **361** is attached to the anchor **362**, and the cylinder **364** is attached to the engagement plate **363**. The assembly **360** includes an extension fluid path **365** for extending the cylinder **364** and a retraction fluid path **366** for retracting the cylinder **364**. As shown in FIG. **10**A, the cylinder **354** is in the extended position and a clearance between the engagement plate **363** and the coupling of the tubular **102** is not present to allow the release of the gripping elements **155**. To release the wedge lock, fluid is supplied through the retraction fluid path **366**, and the extension fluid path **365** is opened. This operation will lift the cylinder **364** up relative to the piston **361** to provide clearance to release the gripping elements **155**, as shown in FIG. **10**B. To return to the extended position, fluid is supplied through the extension fluid path **365** and the retraction fluid path **366** is opened. It is contemplated that one or more piston and cylinder assemblies may be positioned around the mandrel. It is also contemplated that the cylinder may be an annular cylinder around the mandrel. It is further contemplated the cylinder is attached to the anchor and the piston is attached to the engagement plate.

FIGS. **11**A-**11**D illustrate another embodiment of a wedge release mechanism usable with an external gripping tool **200**. The external gripping tool **200** includes the mandrel **110** coupled to a carrier **250**. The mandrel **110** has a load collar **252** which can engage an interior shoulder **254** of the carrier **250**. The mandrel **110** may have a polygonal cross-section such as a square for transferring torque to the carrier **250**. The external gripping tool **200** also includes a plurality of gripping elements **255** and a hydraulic actuator **260** for actuating the gripping elements **255**. The hydraulic actuator **260** may be attached to the carrier **250** using a threaded connection. In one embodiment, the gripping elements **255** are slips disposed in the carrier **250**. Actuation of the hydraulic actuator **260** causes axial movement of the slips relative to the carrier **250**. The gripping elements **255** have wedged shaped back surfaces that engage wedge shaped inner surfaces of the carrier **250**. In this respect, axial movement of the gripping elements **255** relative to the wedge surfaces of the carrier **250** causes radial movement of the gripping elements.

A thread compensator **220** may be used to couple the carrier **250** to the mandrel **110**. In FIG. **11**D, the thread compensator is a spring thread compensator **220** that allows the carrier **250** and its attachments to float independent of the mandrel **110**. In one embodiment, the compensator **220** includes a nut **221** threadedly attached to the exterior of the mandrel **110** and a base plate **222** attached to the mandrel **110**. In this respect, the nut **221** and the base plate **222** are fixed relative to the mandrel **110**. A cover **223** is provided above the base plate **222** and around the nut **221** to support a plurality of pins **224** that extend through apertures in the base plate **222**. Compression springs **225** are disposed around each pin **224** and between the upper portion of the cover **223** and the base plate **222**. In this respect, the springs **225** may exert a biasing force between the cover **223** and the base plate **222**. Because the base plate **222** is fixed to the mandrel **110**, the cover **223** is free to move up and down relative to the base plate **222** as dictated by the springs **225**. The movement of the cover **223** is also referred to herein as floating relative to the base plate **222** or mandrel **110**. The end of the pins **224** protruding from the base plate **222** is connected to the carrier **250**. The pins **224** may be connected to the carrier **250** using a threaded connection. The pins **224** allow the carrier **250** to move with the cover **223** in accordance with the biasing force applied by the springs **225**. It should be noted that the springs may be replaced with hydraulic pistons.

Referring to FIG. **11**A, the carrier **250** is supported by the load collar **252** of the mandrel **110**. The wedge slips **255** are in the retracted position. The tubular is positioned in the carrier **250** such that the coupling **101** is in contact with the engagement plate **270**. A gap exists between the load collar **252** and the engagement plate **270**. In FIG. **11**B, the clamping cylinders **260** are actuated to extend the gripping elements **255** into engagement with the tubular **102**. The gripping elements **255** are urged inwardly by the corresponding wedge surfaces of the carrier **250**. As shown, the relative position of the engagement plate **270** and the mandrel **110** has not changed. If a pushing force is desired, the mandrel **110** will lower down relative to the carrier **250** and come into contact with the engagement plate **270** to place load directly on the tubular **102**. FIG. **11**C shows the mandrel **110** in contact with the engagement plate **270**. In this position, a gap now exists between the load collar **252** and the shoulder **254** of the carrier **250**. The presence of the gap prevents the wedge lock condition from occurring. In one embodiment, the thread compensator **220** will lift the carrier **250** up from the mandrel **110**, thereby creating a clearance between the mandrel **110** and the carrier **250**. The clearance provides the spacing required for the release of the gripping elements **255**.

For operations involving applying a pushing force, the external gripping tool **200** should be lowered over the tubular **102** until a coupling indicator indicates that the coupling **101** has been reached. Then, the gripping elements **255** may be applied to grip the tubular **102**. The connection is then made up. Thereafter, the external gripping tool **200** is lowered until the mandrel **110** reaches the coupling, and the push force may now be applied.

FIG. **12** shows an exemplary tubular handling apparatus **600** having a mandrel **610** coupled to a carrier **650**. A swivel **605** is disposed above the mandrel **610**. A link support housing **613** of a link assembly **108** is attached to the mandrel **610** above the swivel **605**, and a thread compensator **520** is attached to the link support housing **613**. In one embodiment, the tubular handling apparatus may be equipped with a torque measuring device. The torque measuring device includes a torque shaft rotationally coupled to the top drive, a strain gage disposed on the torque shaft for measuring a torque exerted on the torque shaft by the top drive, and an antenna in communication with the strain gage. As shown, the tubular handling apparatus **600** has gripped the tubular **601** using gripping elements **255** such as slips. The slips are actuated by a hydraulic actuator **620** that moves the slips axially relative to the carrier **650**. The tubular **101** is in contact with an engagement plate **670**, which is disposed below the load collar **611** of the mandrel **610**. A fill-up and circulation tool **658** may be installed on the tubular handling apparatus **600**.

FIG. **13** shows a partial view of another embodiment of a wedge lock release mechanism **620** installed on the tubular handling apparatus. The tubular handling apparatus is shown with the mandrel **610** supporting the carrier **650**. The bumper plate **670** is positioned inside the carrier **650** for engagement with the tubular. Engagement with the tubular may cause the bumper plate **670** to move axially relative to the carrier **650**. In one embodiment, the bumper plate **670** is coupled to the carrier **650** using guiding elements **675** that are movable in a slot **655** of the carrier **650**.

The release mechanism **620** acts as a stop member for limiting the upward movement of the guiding elements **655** and the bumper plate **670**. In one embodiment, the release mechanism **620** includes an anchor **622** attached to the carrier **650**. The anchor **622** may be attached using welding or other suitable methods of attachment. In another embodiment, the anchor **622** and the carrier **650** may be formed from one piece of steel or other suitable material. An engagement member **624** is coupled to the anchor **622** using a connection device **626** such as a screw. The engagement member **624** has a wedge surface that is movable along a wedge surface of the anchor **622**. Movement of the engagement member **624** is controlled by releasing the screw **626**. An optional rubber bumper **628** releasably attached to the engagement member **624** may be provided for engagement with the guiding element **675**. The rubber bumper **628** may be exchanged as it wears down from use.

The tubular handling apparatus may optionally include a coupling detection system for indicating presence of a coupling. The coupling detection system includes a coupling indicator **632** connected to the guiding elements. The coupling indicator **632** may be an elongated member having tapered portions to indicate the position of the tubular coupling. A lower end of the coupling indicator **632** is connected to the coupling engagement plate **670** and movable therewith. In one embodiment, the coupling indicator **632** has an upper narrow portion and a lower wide portion to indicate the absence or presence of the coupling. A sensor **635** may be adapted to read the coupling indicator **632** to determine the presence or absence of the coupling in a similar manner as the sensor **175**. FIG. **14** shows the position of the indicator **632** when the guiding element is contacting the rubber bumper **628**. FIG. **15** is a partial exploded view of FIG. **14**.

FIGS. **16-19** are partial exploded views of the tubular handling apparatus in operation. In FIG. **16**, the tubular handling apparatus has been lowered until the bumper plate **670** engages the casing **601**. In one embodiment, the tubular handling apparatus is lowered with the thread compensator **520** activated. In this respect, a substantial portion of the weight of the carrier is borne by the thread compensator **520**, while the remainder is borne by the shoulder of the mandrel **610**. The thread compensator **520** may hold at least 85% of the weight; preferably, at least 95%. As shown, the bumper plate **670** is at the lower end of the slot **655** and has not engaged the release mechanism **620**. In this position, further lowering of the apparatus will lower the carrier **650** relative to the bumper plate **670**, which is resting on top of the casing **601**.

FIG. **17** shows the tubular handling apparatus being lowered further. The carrier **650** has moved relative to the bumper plate **670**, thereby causing the guiding elements **675** to engage rubber bumper **628** of the release mechanism **620**. In this position, further lowering of the apparatus will lower the mandrel **610** relative to the carrier **650**. Also, a substantial portion of the weight of the carrier continues to be borne by the thread compensator **520**, while the remainder is now borne by the bumper plate **670**. The thread compensator **520** may hold at least 85% of the weight; preferably, at least 95%. In addition, the coupling indicator **632** has moved up with the bumper plate **670**, which movement is detected by the sensor **635**.

FIG. **18** shows the mandrel **610** relative to the carrier **650** after the lowering of the tubular handling apparatus has stopped and in anticipation of the thread compensation. As shown, the mandrel **610** is not in contact with the bumper plate **670**. The distance between the load shoulder of the mandrel **610** and the shoulder of the carrier **650** may be used for thread compensation. In one embodiment, a sensor may be provided to measure the optimal distance (i.e., the minimal distance required for thread compensation) has been reached. In another embodiment, a sensor may be provided to warn the distance is insufficient to avoid contact of the mandrel **610** with the bumper plate **670**.

FIG. **19** shows the situation where the mandrel **610** is contacting the bumper plate **670**. This may occur after the

casing has been made up and when a push force is applied to the casing string using the tubular handling apparatus. This position allows axial force to be applied to the casing string without loading the gripping elements.

When the situation shown in FIG. **19** occurs, the carrier **650** cannot move upward to release the gripping elements. This situation may be referred as a "wedge lock" condition. To remedy this situation, the screw **626** may be released from the anchor **622**. FIG. **20** shows the screw **626** in the unreleased position. FIG. **21** shows the screw **626** in the released position. As the screw **626** is released from the anchor **622**, the engagement member **624** is moved along the wedge surface and away from the guiding elements **675**, thereby creating a space **660** between the rubber bumper **628** and guiding elements **675**. The space **660** allows the carrier **650** to move axially relative to the gripping elements, thereby releasing the gripping elements from the casing.

Actuation of each mechanism described herein may be manual, hydraulic, pneumatic or electric. Actuation may further be initiated locally at the tool or remotely from a control panel. Furthermore, actuation may be triggered automatically by a control command to release the slips. In all embodiments, the devices may be reset to their original positions after the slips have been released from the tubular.

In all embodiments, the devices may be reset to their original positions after the slips have been released from the tubular. Resetting may be manual, hydraulic, pneumatic or electric. Resetting may further be initiated locally at the tool or remotely from a control panel. Furthermore, Resetting may be triggered automatically by a control command, for example to engage the slips. In all embodiments, the devices may be reset to their original positions after the slips have been released from the tubular.

In addition to casing, aspects of the present invention are equally suited to handle tubulars such as drill pipe, tubing, and other types of tubulars known to a person of ordinary skill in the art. Moreover, the tubular handling operations contemplated herein may include connection and disconnection of tubulars as well as running in or pulling out tubulars from the well.

In another embodiment, a release apparatus for releasing a gripping element of a tubular handling apparatus includes an anchor attached to the tubular handling apparatus and an engagement member for engaging the tubular, wherein the position of the engagement member relative to the anchor is selectively adjustable to allow for relative axial movement between the anchor and the tubular. In yet another embodiment, the release apparatus is configured to be manually actuated or remotely actuated. In yet another embodiment, the release apparatus is configured to be hydraulically actuated, pneumatically actuated, electrically actuated, and combinations thereof. In yet another embodiment, the release apparatus is configured to be resettable.

In one embodiment, a release apparatus for releasing a gripping element of a tubular handling apparatus includes an anchor attached to the tubular handling apparatus; an engagement member for engaging the tubular; and an abutment device disposed between the anchor and the engagement member, wherein a length of the abutment device is adjustable relative to the anchor.

In another embodiment, a tubular handling apparatus for handling a tubular includes a mandrel; a carrier coupled to the mandrel; a gripping element for engaging the tubular; an engagement member coupled to the carrier for engaging an upper portion of the tubular; and an abutment device adapted to engage the engagement member, wherein a length of the abutment device is adjustable to allow movement of the engagement member. Further, the length of the abutment device may be adjusted manually or by remote actuation.

While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

We claim:

1. A release apparatus for releasing a gripping element of a tubular handling apparatus, comprising:

an engagement member for engaging a top end surface of a tubular;

an anchor attached to the tubular handling apparatus;

an abutment device for limiting movement of the engagement member, wherein the abutment device is selectively movable along an inclined surface of the anchor; and

a connection device coupling the abutment device to the anchor, wherein the connection device is adjustable to move the abutment device relative to the anchor.

2. The apparatus of claim **1**, wherein the abutment device is disposed between the anchor and the engagement member.

3. The apparatus of claim **1**, wherein the connection device comprises a screw.

4. The apparatus of claim **1**, further comprising a bumper attached to the abutment device.

5. The release apparatus of claim **1**, wherein the release apparatus is configured to be manually actuated or remotely actuated.

6. The release apparatus of claim **1**, wherein the release apparatus is configured to be resettable.

7. The apparatus of claim **1**, wherein the engagement member comprises a plate.

8. The apparatus of claim **1**, wherein the engagement member is positioned transversely relative to a longitudinal axis of the tubular handling apparatus.

9. The apparatus of claim **8**, wherein the engagement member comprises a plate.

10. The release apparatus of claim **1**, wherein the engagement member prevents upward movement of the tubular but allows downward movement of the tubular when engaged with the upper end of the tubular.

11. A tubular handling apparatus for handling a tubular, comprising:

a mandrel;

a gripping element for gripping the tubular;

an actuator coupled to the mandrel and axially movable relative to the mandrel for engaging or disengaging the gripping element from the tubular;

an engagement member for engaging a top end surface of the tubular; and

an abutment device adapted to limit axial travel of the engagement member, wherein movement of the abutment device is independent from movement of the mandrel.

12. The apparatus of claim **11**, further comprising an anchor attached to the actuator.

13. The apparatus of claim **12**, wherein the abutment device is movable relative to the anchor.

14. The apparatus of claim **13**, wherein the abutment device moves along an incline of the anchor.

15. A method of releasing from a wedge lock condition during a tubular handling operation, comprising:

providing a tubular handling apparatus having a mandrel, a gripping element movable along the mandrel, and an engagement member for contacting a tubular;

attaching a release mechanism to the mandrel, wherein the release mechanism includes an anchor, an abutment device axially movable relative to the anchor, and a connection device coupling the abutment device to the anchor;

engaging the tubular to the engagement member and the engagement member to the abutment device;

adjusting the connection device to move the abutment device away from the engagement member;

moving the mandrel relative to the engagement member; and

releasing the gripping element.

16. The method of claim **15**, wherein adjusting the connection device comprises rotating the connection device.

17. The method of claim **15**, wherein the abutment device moves along an incline of the anchor.

18. The method of claim **15**, further comprising coupling an indicator to the engagement member.

19. The method of claim **15**, linking operation of the release mechanism to the operation of a clamping cylinder.

20. A release apparatus for releasing a gripping element of a tubular handling apparatus, comprising:

an engagement member for engaging a top end surface of a tubular;

an anchor attached to the tubular handling apparatus;

an abutment device for limiting movement of the engagement member, wherein the abutment device is disposed between the anchor and the engagement member; and

a connection device coupling the abutment device to the anchor, wherein the connection device is adjustable to move the abutment device relative to the anchor.

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